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EXAMINATION PAPERS
IN ARITHMETIC

IN FOUR PARTS.

BY

BARNARD SMITH, M.A.
RECTOR OF GLASTON, RUTLAND, AND LATE FELLOW AND
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THE object of these *Examination Papers* is to test Students both in the Theory and Practice of Arithmetic. It is hoped that the method adopted will lead Students to deduce results from general principles rather than to apply stated Rules. The Author believes that the practice of giving examples under particular Rules makes the working of Arithmetic quite mechanical, and tends to throw all but very clever boys off their balance, when a general paper on the subject is put before them.

A Key to the work is now published.

Numerous Examples are given in the Author's previously published *Exercises in Arithmetic.*

GLASTON RECTORY.

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EXAMINATION PAPERS.

PART I.

PAPERS (I—XVIII) ON SIMPLE RULES.

I.

1. (*a*) Write in figures each of the numbers, two, five, eight, ten, thirteen, sixteen, nineteen.

(*b*) Write in words each of the numbers, 4, 7, 11, 15, 17, 20. What is writing words in figures called?

2. (*a*) Write down the figure which stands for one, or unity. Make the sign which is written between numbers which have to be added together; what is this sign called?

(*b*) Write down 2 as made up of the addition of single units with the sign of addition between the units; write down in like manner the values of 3, 5, 8, 10, 13, and eighteen.

3. Work the following examples in addition:

$$\begin{array}{ccccc} 4 & 2 & 5 & 7 & 8 \\ \underline{4} & \underline{6} & \underline{5} & \underline{9} & \underline{6} \end{array}$$

What is the *answer* in each of the above examples called?

4. Find the sum of (1) 6, 2, and 1; (2) of 5, 0, and 6; (3) of seven, 2, 0, and five; (4) of six, nought, nine, and nought; (5) of 2, nine, 0, one, and four.

5. (*a*) James bought 5 oranges, and Sam bought one more than James. How many did both buy?

(*b*) Jack, having sold Tom 3 oranges, Mary 9, and Fred 4 more than Tom bought, had 1 left in his basket. How many oranges were there in the basket at first?

(*c*) Fanny had 4 hens; the 1st laid 5 eggs in the week, the 2nd none, the 3rd two more than the 1st, the 4th as many as the 1st and 3rd. How many eggs did all the hens lay?

II.

1. (*a*) How many units are there in the 1 in 10? How many tens and how many single ones are there in eleven, fourteen, seven, nineteen, twenty?

(*b*) Find the sum of (1) 5+6+0+3; (2) 9+0+7+0+2; (3) 6+8+2+5+0; (4) 4+6+9+1.

2. (*a*) Write in words 16, 22, 35, 40; and (*b*) in figures, nine, fourteen, forty-one, twenty-six, sixty-two. What is writing figures in words called?

3. (*a*) Seven years ago Charles was eleven years old: how old is he now?

(*b*) Tom bought some oranges for 7*d.*, some nuts for 4*d.*, and some cakes for 9*d.*; how many pence did he spend?

4. (*a*) In the 1st class there are four girls and seven boys; in the 2nd as many girls as there are boys in the 1st, and two more boys than girls; in the 3rd as many boys as there are boys in the 1st two classes, and as many girls as there are boys in the 2nd. How many girls are there in the school? How many boys and girls?

(*b*) Edith's cat caught 3 mice on Monday, 5 more on Tuesday than on Monday, 5 more on Wednesday than she caught on both the previous days: her mother gave her 1*d.* for each mouse. How many pence did she receive?

5. Work the following examples in subtraction:

$$\begin{array}{ccccc} 8 & 6 & 9 & 8 & 7 \\ \underline{5} & \underline{6} & \underline{3} & \underline{1} & \underline{2} \end{array}$$

What is the *answer* in each of the above examples called? What is the number which you subtract often called? Make the sign of subtraction; what is this sign called?

6. Emily is nine years old, and Baby is two years old. How old was Emily when Baby was born? How old will Emily be when Baby is as old as Emily now is?

III.

1. What is the difference between Numeration and Notation? Make it clear by taking the word twenty, and the number 20. What is a whole number or integer?

2. (*a*) Write in figures each of the numbers seven, seventeen, two, twenty. How many more units are there in seventeen than in seven? How many more in twenty than in two?

(*b*) Is there any difference in value between 2 and 02? If so; what?

3. (*a*) Find the value of

(1) 5+5+0+9+6+5; (2) 7+2+8+6+8;
(3) 9+2+0+5+0+6; (4) 8+5+6+0+2+9;
(5) 9−5; (6) 8−2.

(*b*) Add

(1)	(2)	(3)
206	4038	2970
847	700	7898
195	5999	3047

(*c*)

	(1)	(2)	(3)
From	70	182	300
Take	58	89	103

Explain clearly each step in the working of Exs. (1) in (*b*) and (*c*).

4. (*a*) Jane gathered 8 flowers, tulips and pinks; she had 3 tulips; how many more pinks than tulips did she gather?

(*b*) The cloth for Ned's jacket cost 9*s.*, the cutting it out cost 1*s.*, the lining and buttons 3*s.*, and the making it as much as the cutting out, lining and buttons. What did the jacket cost?

5. (*a*) Mr Stafford and Mr Warren had each the same amount of money in his pocket in the morning: during the day Mr Stafford lost £6, and Mr Warren gained £16. In the evening, which had the larger amount, and how much larger?

(*b*) John, Harry and Charlie have between them eightpence; John and Charlie have five pence, and Harry and Charlie have seven pence: how many pence has each of them? How many more pence has Charlie than John?

IV.

1. (*a*) What does Arithmetic teach us? What is 0 called? Has it any value when standing by itself? write down the values of 4, 40, 004, 4000. If you write 00000 after 4, what number does it make?

(*b*) Write in figures one hundred and twenty-six, five hundred and seven, five hundred and seventy, eight hundred and fifty-nine, two hundred and ninety-five. Write in words 417, 590, 659, 886, 900, 607, 067.

2. (*a*) 7+7 make 14; why so? 17+3 make 20; why so?

(*b*) A jobber bought three flocks of sheep. The 1st contained two hundred and thirty; the 2nd one hundred and ten more than the 1st; and the 3rd eighty-five more than the 2nd: how many sheep did he buy in all?

3. (*a*) Find the sum of (1) 1347, 506, 3280, 937, 80; (2) 7637, 806, 1900, 2284, 205; (3) 8871, 3088, 78, 707, 2099.

Why put units under units, tens under tens, &c.?

(*b*) (1) From 473 take 269; (2) from 760 take 584; (3) from 1000 take 99. Explain clearly the reason of each step in (1).

4. (*a*) Mr Osborn had 7 bullocks and 6 cows before the cattle plague: all his cows, but one, died of it; during the plague he bought 8 bullocks and 4 cows, all of which are now alive except 1 bullock: how many cows and bullocks has he at the present time? has he more bullocks than cows? if so, how many?

(*b*) How much is the sum of five and three greater than their difference?

5. (*a*) A person, who was born in 1779, died at the age of 46 years; his son died 27 years afterwards, and his daughter died 13 years after the son: in what year did the daughter die?

(*b*) In a National School containing 62 scholars, 35 are girls; how many more girls are there than boys?

V.

1. Express in words the numbers 207, 2700, 20007, 2007000, 200000070; and in figures four hundred and eighty-one, six thousand and ninety, three hundred thousand four hundred and one, fifty-two millions forty-three thousand and sixteen.

2. (*a*) Find the sum of

(1) 80603, 187500, 355, 70087, 6609, 502290.

(2) 17005, 306604, 73, 4030882, 806597, 18800.

(*b*) Find the difference between (1) 7134 and 6845; (2) three thousand and ten, and two thousand one hundred and one.

Explain clearly the method of working Ex. (1) in (*b*).

3. (*a*) A butcher bought 8 pigs of one man, and 9 of another; he killed 3 of the 1st lot, and 2 of the 2nd; how many pigs had he left?

(*b*) Tom sold his top for 2*d*., his knife for 9*d*., his rabbit for 7*d*., and then bought an arithmetic for 4*d*., and a slate and pencil for 6*d*.: the rest he put into his money box; how much less did he put into his box than he spent?

4. Explain shortly how the Romans used to calculate.

(*a*) What numbers do III, VI, IX, X, XVIII represent?

(*b*) Write the numbers 4, 7, 12, 19, 20 in Roman characters.

5. (*a*) A poor man had in his garden nineteen fruit trees, consisting of apple, pear and cherry trees: the number of cherry and apple trees was fourteen; and the number of apple and pear trees was thirteen. How many more pear and cherry trees had he than apple trees?

(*b*) The sum of two numbers is fifteen hundred and seven, the smaller of them is six hundred and twenty-eight; find the larger number.

VI.

1. (*a*) What is the value of (1) $8-6+5$;

(2) $6+0-5+8$; (3) $5-5+0+8-5$; (4) $9-2-0-3+7$?

(*b*) What is the difference between $37-14+7-3$, and $16-3-9+11+7$?

2. (*a*) How much is the difference between 628716 and 79019 greater than the sum of 56095, 2800, 10009, 7097, 159, 3000, and 90829?

(*b*) A man being asked how much money he was worth, replied, If you will give me four hundred and fifty-three thousand and sixty-three shillings, I shall have two millions of shillings. How much was he worth?

3. (*a*) Mr Stokes bought 3 houses; for the 1st he gave 5260*s*., for the second 3585*s*., and for the 3rd as much as for the 1st two less 29*s*. He afterwards sold the houses for 20000*s*. What did he gain?

What does the sign = mean?

(*b*) 9 less $6=3$, 14 less $8=6$, 20 less $9=11$: explain clearly in each case why this is so?

4. (*a*) A speculator gained £3560, and afterwards lost £3479; he then gained £6283, and then lost first £1089, and then £2361: by how much did his gains exceed his losses?

(*b*) Express in the Roman Notation 8, 11, 36, 50, 70, 126, and XXIX, LXXXIII, CCVI in numbers.

5. The Duke of Wellington died in the year 1852, aged 83; Napoleon was born in the same year as the Duke, and died in 1821; what was Napoleon's age at the time of his death?

VII.

1. (*a*) Write down in words the difference between ten millions, and the sum of sixty-one thousand and nine, ninety-eight, seven thousand and fifty, nine millions six hundred and one, and fifty thousand five hundred.

(*b*) What number must be added to 50 + 2756 + 406 + 530 to make the sum = 4736 + 57 + 784 + 8546?

2. (*a*) A man travelled 22 miles on Monday, 26 miles further on Tuesday, 15 miles back again on Wednesday, 35 miles in the opposite direction on Thursday, and 17 miles back again on Friday. How many miles was he on Friday night from the point from which he started on Wednesday morning? Was he nearer the point he started from on Monday, or further from it?

(*b*) *A* is 27 yrs. older than *B*, and 15 yrs. younger than *C*, who is 54 yrs. of age; *D* is as old as the sum of *A*'s and *B*'s ages. Is *C* older or younger than *D*? How much?

3. If you cut off three cyphers from the number 2080000, by how many units will you decrease the value of the figure 8?

4. (*a*) What do you mean by saying that 4 is to be multiplied by 3? What is the sign of multiplication? Make it.

(*b*) Multiply	58	207	420	950
by	63	74	95	80

What is the *result* in each Ex. called? Which is the multiplicand? What is the other number called?

5. (*a*) A boy bought a cap and 4 pairs of gloves for 19*s.*, the gloves cost 3*s.* less than the cap. Find the cost of the gloves.

(*b*) Four old Aunts were born as follows, the 1st in 1776, the 2nd in 1781, the 3rd in 1789, and the 4th in 1795; find the sum of their ages in 1866; find also whether the sum of the ages of the eldest and youngest is greater or less than the sum of the ages of the other two? Explain by this Ex. how the results of sums in addition and subtraction are proved to be true.

VIII.

1. (*a*) A gentleman leaves by will £25702; to each of his three daughters he leaves £3450, and the remainder to his only son. By how much does the son's portion exceed a daughter's?

(*b*) The larger of two numbers is ten thousand and one, and their difference is one thousand and nine; find the smaller number. Shew by means of this Ex. how sums in subtraction are proved.

2. How much greater is $50+36-12$ than $30-6-13+7$? What must be added to the difference between $35-10-6$, and $30-6+20$ to make the sum of $4+15-9$ and $25-7-4+11$?

3. (*a*) *A* has 74 marbles, *B* has 34 more than *A*, and *C* has 16 more than *B*, *A* gives *B* and *C* each 19, *B* gives *A* and *C* each 34, and *C* gives *A* and *B* each 10. How many marbles have *A*, *B*, and *C*, respectively after these exchanges?

(*b*) Two baskets contain apples; the 1st, 350, 2nd, 500: if 3 score be sold out of the 1st, and then 4 dozen be put out of the 2nd into the 1st, and then 12½ dozen be sold out of the 2nd, and 87 be put out of the 1st into the 2nd, how many apples will there be in each basket?

4. (*a*) Multiply (1) 7098 by 257, (2) 25607 by 3094, (3) five hundred and forty thousand six hundred and nine by seventeen hundred and fifty.

Explain every step in the working of (1).

(*b*) How much greater is the product of 17 and 15 than the product of their sum and difference?

5. (*a*) There are 16 houses, each house has 28 windows, 17 of which windows each has 12 panes of glass, and the rest each 8 panes; how many panes of glass are there in the 16 houses?

(*b*) A drover bought 127 fat bullocks at £34 a head, and 97 others at £47 a head; he sold the whole lot at £40 a head: what was his whole gain or loss?

IX.

1. Define Notation. How many kinds of Notation are there?

(*a*) What number added to eight hundred and seventy thousand five hundred and eighty-nine will amount to twenty millions eighty-three thousand six hundred and seventy?

(*b*) What number added to XCVII will amount to CCVI? If CCXCVII be subtracted from DXXXVI, by how much will the remainder exceed CXL? Express the results (1) in Arabic figures, (2) in Roman characters.

2. What is a "factor"? How would you put down 6 × 5 as an addition sum?

Multiply seventeen thousand six hundred and four by five hundred and nine; and from the result deduce the product of seventeen millions six hundred and four thousand, by five thousand and ninety.

3. (*a*) If 1 mile of railway require 113 tons of iron at £11 a ton, what will be the cost of the iron to construct a railway 209 miles in length?

(*b*) A farmer sold 197 bus. of wheat at 7*s.* a bus., for which he received 13 calves at 97*s.* each, 3 pigs at 17*s.* each, and the rest in money. What money did he receive?

4. (*a*) The sum of two numbers is 360, the less is 114; what is the product of the numbers?

(*b*) If 17 men can build a house in 98 days, how long ought it to take 1 man to build it?

5. A pond has an outlet, which empties 53 gallons an hour, and an inlet, which fills 101 gallons an hour. The pond has 106 gallons of water in it at a certain time, when the inlet is set running; two hours afterwards the outlet is also set at work; find the number of gallons of water in the pond at the end of 11 hours from the time when the outlet is set to work.

X.

1. (*a*) Tom and Harry played at marbles, each having 58. At "Ring Taw" Harry won all Tom's marbles but 9, he then sold Tom 25, and at "Lag" Tom won 16. How many more marbles had Harry than Tom when they left off?

(*b*) What number must be added to the sum of sixty-four thousand and one, seven millions one thousand and sixty, MDCCIX, 77007, $\overline{\mathrm{MC}}$, fifty-six thousand seven hundred and eighty-nine to make the result ten millions?

2. (*a*) Multiply 580 by 307, and explain how you obtain each figure in the working of the sum.

(*b*) Shew that whether you multiply 38 by 24, or by 6, and the result by 4, or by 3 and the result by 2, and the next result by 4, the final result will be the same.

3. (*a*) What is Simple Division? Make your definition clear by taking 6 divided by 2 as an Ex. What is the sign of Division? make it. How often can 3 be subtracted from 41?

(*b*) Divide 131385 by 57, and 3956120 by 507.

4. (*a*) How much is 5 times the product of the sum and difference of 364 and 226?

(*b*) In the year 1862, four hundred and forty-seven years had passed since the battle of Agincourt; how many years was that battle fought before the battle of Waterloo, which took place in the year 1815? Explain each step of this sum.

5. (*a*) If the pulse of a man at middle age beat one hundred and eight thousand times in 24 hours, how many times does it beat on the average every minute? 1 hr. = 60 min.

(*b*) What number is that, which being divided by 7, the quotient multiplied by 3, the product divided by 5, and this quotient increased by 40, the sum will be 100?

XI.

1. (*a*) Find the sum of 78, 824704, 65065050, 9034, 9290000, 706888, 10673009, and 7777. (*b*) By how much does the difference between one hundred and fifty-one millions ten thousand six hundred and ninety-eight, *and* twenty-one millions ninety thousand nine hundred and ninety-nine fall short of one hundred and thirty millions?

2. (*a*) A farmer bought a pig for 36*s*., a sheep for 25*s*. more than he gave for the pig, a calf for as much as he gave for the pig and sheep, some hens for 8*s*. less than he gave for the sheep: being no scholar he offers 300*s*. to pay for them: how much ought he to receive back?

(*b*) Bill asked Ned how many apples he had gathered; Ned replied, If you take the difference between 576 − 208 + 1645 − 321 and 403 − 256 + 814 − 195, the answer will exceed the number by 26. How many apples had Ned gathered?

3. What is meant by continued multiplication?

(*a*) Multiply the difference between 876042 and 834260 by 4 times the sum of 1200 and 1082.

(*b*) A drover bought 97 pigs at 27*s*. a head, it cost him 4*s*. a head for food, 3 of the pigs died on their way to the market, he sold the rest at 39*s*. a head: how much did he gain?

4. (*a*) Divide 60450720 by 11, the quotient by 10, the 2nd quotient by 12: shew that the result is the same as if you had divided the given number by 1320; why is this so?

(*b*) What number must be multiplied by 327 to produce 1203033?

5. (*a*) Mr Johnson bought 15 cows; having sold 9 of them for £18 each, and the rest for £15 each, he found that he had lost £3 by his bargain; what did he give for each of the cows?

(*b*) There were 1120 pears on a tree. The owner gathered 14 daily for 23 days; he divided the remainder as far as he could between his son and his daughter, giving the former 5 for every 3 which he gave the latter: how many pears did the son receive more than the daughter?

XII.

1. (*a*) In the Roman Notation how does a line over a letter or letters affect their value? Express in the Arabic Notation XLVIII, CIII, $\overline{\mathrm{C}}\mathrm{III}$, $\overline{\mathrm{CI}}\mathrm{II}$, MDCCCLXVI.

(*b*) Find the value of

(1) $70563 - 784 - 59990 + 561 + 9650$.

(2) $60931 - 5009 + 90089 - 77700 + 73021$.

(3) XCIX + LVI − XXXIV − L + CCXXI.

2. (*a*) Stamford by the L. and N. W. Railway is 109 miles from London: Seaton is 33 miles nearer Stamford than Northampton is, which is 34 miles further from London than it is from Seaton; how far is Seaton from Stamford?

(*b*) Napoleon III. was born in the year 1808, and Queen Victoria in 1819; how many years since, reckoning from 1866, was Napoleon just twice as old as the Queen was at that time?

3. (*a*) What number subtracted from nine hundred and ninety will make the result equal to the difference between two thousand, five hundred and fifteen, and eighteen hundred and nine?

(*b*) Walter's waistcoat, jacket and trousers cost altogether 36*s*., the jacket cost 3*s*. more than the waistcoat, and the trousers and waistcoat cost 24*s*. What did each of them cost?

(*c*) *A* says to *B* and *C*, I have 1650 sheep; *B* replies, If I had 753 more than I have, I should have as many as you have; *C* adds, If I had 105 more than I have, I should have as many as both of you. How many more sheep had *C* than *B*?

4. (*a*) The product of two numbers is 1270374, and half one of them is 3129; what is the other number?

(*b*) Shew that 5 times the product of the sum and difference of 364 and 226 is less than the quotient of 28563614040, and 70008 by 905.

5. (*a*) If 17 men can dig a field in 6 days, how many days ought 4 boys to take to dig the field, it being given that 1 man can do twice as much work as a boy in a given time?

(*b*) The nuts in a bag were divided among 59 boys and 27 girls: each boy had 3 times as many as each girl; there were just nuts enough and one over to give the girls 7 nuts apiece. How many nuts did the bag contain?

XIII.

1. (*a*) Write in words 20810976, and $\overline{\text{MC}}$CCCXL; in figures three hundred millions seven hundred and three thousand and forty-seven; in Roman characters, 34, 77, 398, 5090.

(*b*) Add together the six numbers you can make with the three figures 3, 4, 5. Explain clearly the method of adding.

(*c*) On the 30th March 1866, Government reported that two hundred and nine thousand and twenty-two head of cattle had been attacked by the cattle disease: of which number forty-four thousand three hundred and five had been killed, one hundred and twenty-one thousand three hundred and sixty-nine had died, twenty-nine thousand two hundred and eighty-six had recovered: how many head of cattle were unaccounted for in the report?

2. Explain the meaning of the terms plus, subtrahend, product, divisor.

(*a*) Multiply 18172 by 9, and divide 1715823 by 27; find the difference between the product and the quotient.

(*b*) If 16 men can perform a job of work in 36 days, in how many days can they perform the same job with the assistance of 2 more men?

3. (*a*) A person bought 68 bales of linen containing 67048 yds., each bale contained 34 pieces, and each piece contained the same number of yds.; find the number of yds. in each piece.

(*b*) The quotient being 958 and the divisor 607, find the dividend. What would the dividend be, had there been a remainder 44?

4. (*a*) Explain by means of the examples, 7856 ÷ 900, and 1548036 ÷ 4300, how a division sum may be shortened, if the divisor terminate with cyphers.

(*b*) What number is that which being divided by 45, the quotient increased by 50, the sum diminished by the difference between 28 and 16, the remainder multiplied by 6, and the product divided by 24, the quotient will be 12?

5. (*a*) A salesman bought 25 beasts at £18 each, but lost 4 of them by the cattle plague: at what average price must he sell the remainder, so as to lose only £30 by his bargain?

(*b*) Distribute 600 eggs between *A*, *B*, and *C*, giving *B* 3 times as many as *A*, and *C* twice as many as *B*.

XIV.

1. (*a*) Explain how 20408 is known to mean twenty thousand four hundred and eight.

(*b*) What number added to the difference of 3000 and 1729 will give the sum of 40366, 2709, and 30916?

2. (*a*) What number besides 472 will divide two hundred and fifty-one thousand one hundred and four without a remainder?

(*b*) Of what number is 7036 both divisor and quotient?

3. (*a*) James and Frank start from the same point, and travel along the same road in the same direction, James travels 9 miles the 1st hr., 7 miles the 2nd hr., 8 miles the 3rd hr., and 3 miles the 4th hr., and Frank travels 6 miles each of the two 1st hrs., and 7 miles each of the two last hrs.; how far will they be apart at the end of the time?

(*b*) If however at the end of the 1st hr. James instead of going on, turn back, and travel in the opposite direction 7 miles an hr. for each of the 3 remaining hrs., how far will they then be apart at the end of the time?

4. (*a*) *A*, *B*, *C*, and *D*, have among them 69 sovereigns; *A*, *B*, and *C* have among them 48; *B* and *C* 31, *B* having 15 more than *C*: how many more sovereigns have *A* and *B* than *C* and *D*?

(*b*) The Norman Conquest took place in the year 1066, Queen Victoria began her reign in 1837, 77 years after George III. began his reign. How many years after the Conquest did George III. ascend the Throne?

Explain each step of the operation.

5. (*a*) If 6 lbs. of sugar cost 42*d.*, what ought 25 lbs. to cost?

(*b*) A bullock weighs 6 times as much as a butcher; they both weigh 1211 lbs.: how many lbs. does the bullock weigh more than the man?

(*c*) Distribute 240 yds. of flannel among 10 old men, 13 old women, and 4 families, giving each old woman the shares of two old men, and each family the shares of an old man and old woman.

XV.

1. (*a*) A number increased by 13 times itself amounts to twenty millions five thousand and six; find the number.

(*b*) If the sum of 250 and 173 be multiplied by their difference, and the product be divided by 33, find the result.

2. Explain the terms minus, multiplier, quotient.

(*a*) Divide 2373 by 24, and also by its factors 4 and 6, and shew clearly that the remainder is the same in both cases.

(*b*) A jobber having bought a flock of sheep for 18130*s*., and having sold 84 of them to a butcher at 51*s*. each, the rest stood him in 43*s*. each. How many did he buy?

3. (*a*) Shew that any number which will exactly divide each of two numbers will divide their sum.

(*b*) Shew that a number is divisible by 2 if its right-hand figure is even, or divisible by 2.

4. (*a*) If 15 men can do a piece of work in 16 days, in how many days will 20 men do the work?

(*b*) 756 votes were given for two candidates, the elected one had a majority of 34; how many votes had each?

5. (*a*) A grocer having 252 lbs. of moist sugar, wishes to pack it in parcels of 1 lb., 3 lbs., and 5 lbs.; there are to be the same number of parcels of each kind. How many parcels can he make?

(*b*) A horsedealer gave £5880 for a certain number of horses, and sold a part of them for £3510 at £65 each, and by so doing lost £5 a head; for how much a head must he sell the remainder to gain £660 on the whole?

XVI.

1. (*a*) Find the sum of the 9 numbers that follow the number ninety thousand eight hundred and seventy-eight.

(*b*) What number is that from which if you take 18268 the remainder will be 26017 less 17312? Explain the reason for each step of the working of (*a*) and (*b*).

2. (*a*) The product of 16 by 19 is 304. How much must be added to it to get the product of 18 by 19, and how much must be taken from it to get the product of 16 by 17?

(*b*) It being given that 1 qr. = 8 bus., 1 bus. = 4 pks., 1 pk. = 16 pts., how many pints of potatoes are there in 207 qrs.?

3. What are Composite numbers? What are Prime numbers? Give examples of each.

Split the following numbers into their prime factors; 35, 24, 84, 96, 105, 436, and 1000.

4. (*a*) The product of three numbers is five hundred and thirty-five thousand five hundred; one of the numbers is 75, another is 68. What is the third?

(*b*) What number is that, which being divided by 24, the quotient increased by 26, the sum diminished by the difference between 40 and 27, the remainder multiplied by 4, and the product divided by 11, will give 12 for a quotient?

5. (*a*) A dealer purchased a lot of horses and bullocks for £2000, paying twice as much for a horse as for a bullock. There were three times as many bullocks as horses, and the horses cost him £80 each. Required the number of bullocks.

(*b*) If 435 men require 13485 rations of bread for the month of July, how many rations will a garrison of 3500 men require for the same time?

XVII.

1. (*a*) Subtract 700027 from 2170292, and 700027 again from the remainder, and then 700027 again from the last remainder. Explain how this is the same as dividing 2170292 by 700027.

(*b*) Multiply 7050231 separately by 9, by 40, and by 600; add the products together. Point out how the ordinary method of multiplying 7050231 by 649 agrees step by step with the above.

2. (*a*) A postman walks 14 miles a day: how many steps does he take in a week (6 days); each step being 1 yd. in length, and 1 mi. being 1760 yds.? How many miles does he walk in a month? How many in twelve months?

(*b*) If he took 3 steps in every 2 yds.; how many steps would he take in a week?

3. (*a*) Find the sum of 809 × 14, and 5919122 ÷ 43; subtract 31920; and divide the remainder by 30.

(*b*) God called Abram B.C. 1921, Abram being then 75 yrs. old, he died aged 175 yrs. Isaac died B.C. 1716, aged 180 yrs.; how old was Abraham at the birth of Isaac?

4. Shew that any number, which will exactly divide one of two numbers, will divide their product.

(*a*) If 5 pints of plums cost 10*d.*, how much more ought 13 pints to cost than 4 pints?

(*b*) If the wages of 20 men for 4 days amount to 240*s.*, how many men ought to work 16 days to receive 144*s.*?

5. (*a*) The quotient being = 5 times divisor = 7 times remainder = 105; find the dividend.

(*b*) A man, having bought an estate of 1256 acres, sold 1000 ac. of it at £70 an ac., and the remainder at £63 an ac.; gaining thereby on his purchase-money £15792: at what price per ac. did he purchase the estate?

6. (*a*) Split into their prime factors, 27, 56, 78, 144, 254, and 500.

(*b*) Divide £3975 among *A*, *B*, *C*, and *D*; so that *B* may have £23 more than *A*, *C* £45 more than *A* and *B* together, and *D* £29 less than *B* and *C* together.

(*c*) In walking a certain distance *A* takes 10720 steps; how many steps will *B* take in walking half the distance, *A* taking 4 steps for every 5 steps of *B*'s?

(*d*) 60 men can execute a piece of work in 24 days; after 8 days' work, 12 of the men leave. Shew that the men left can finish the work in 20 days.

XVIII.

1. (*a*) How much more will remain if I subtract 17 from the sum of 53 and 27, than if I subtract 17 from the difference of 53 and 27?

(*b*) A man has a heap of potatoes; he sells two hundred and eight, and then one hundred and seventeen; he then adds to the heap five hundred and fifty-six; he afterwards sells one hundred and twenty-nine; he then counts the number left, and finds it five thousand and sixty. What number of potatoes were there in the heap after the 1st sale?

2. (*a*) The product of 3 numbers is 8937992; the 3rd is double the 2nd, and the sum of the 2nd and 3rd is 906; find the 1st.

(*b*) I divided 120 apples among an equal number of boys and girls. For every 2 apples that a boy had, a girl had 3. How many boys and girls were there?

3. (*a*) How many railway trucks each containing 6 tons must a merchant send to bring 1035 tons of coals? Explain clearly the method of working this sum.

(*b*) Fanny is now (in 1866) 13 yrs. old; 4 yrs. ago her father was 5 times as old as she then was; what will his age be in 1870. Supposing him to be 2 yrs. older than the Queen, in what year was she born?

4. Shew that any number, which will exactly divide each of two numbers, will divide their difference.

(*a*) One half the sum of two numbers is 800, and one half the difference of the same numbers is 200; what are the numbers?

(*b*) At a certain election 3000 votes (plumpers) were given for A, B, and C; B polled 200 votes more than A, and C 800 more than B; shew that A polled just one-fifth of the number of votes given.

5. (*a*) Split 135, 126, 432, 255, and 1207 into their prime factors.

(*b*) A grazier bought a certain number of bullocks for £4900, and sold a part of them for £3840 at £32 a-head, and gained on those he sold £480. How much did he gain a-head, and how many did he buy at first?

6. (*a*) 4 lbs. of tea are worth 9 lbs. of coffee, and 6 lbs. of coffee are worth 15 lbs. of sugar; how many lbs. of sugar are equal to 56 lbs. of tea? 315

(*b*) A gentlemen left by will £2250 between A, B, and C; B was to have £90 less than A, and C £90 more than A; after his death it was found that his effects were worth only £2000; and £200 had to be deducted from this amount before distribution; what legacy did A, B, and C, each receive? 600 528 672

(*c*) The sum of the diameters of the sun and earth being eight hundred and ninety-four thousand and fifty-six miles, and the diameter of the sun being 112 times as great as the diameter of the earth, find the diameter of the earth.

EXAMINATION PAPERS.

PART II.

PAPERS (XIX—XXXIII) ON SIMPLE RULES, COMPOUND RULES AND PRACTICE.

XIX.

1. (*a*) The population of the United States in 1860, consisting of white, free coloured and slaves, amounted to thirty-one millions four hundred and forty-five thousand and eighty-nine; the white and free coloured together amounted to twenty-seven millions four hundred and sixty-three thousand five hundred and eighty, and they exceeded the number of free coloured and slaves by four millions four hundred and forty-one thousand seven hundred and sixty-five. Find the number in each class.

(*b*) The smaller of two numbers is contained 32 times in 576, and the greater number is 18 times the smaller: find the product of the numbers.

2. (*a*) A father is 46 yrs. old, and his son is 16 yrs. old: in how many yrs. will the father's age be twice the son's?

(*b*) Write down three numbers, the sum of which makes a million, each number being greater than three hundred thousand and less than four hundred thousand; subtract six thousand and forty-one from the sum. Use this Ex. to explain fully the principles of addition and subtraction.

3. (*a*) What number is that, from which if you deduct 26, the remainder will be one-half of 754?

(*b*) A farmer has 2520*s.*, with which he can buy a certain number of calves at 81*s.* each, twice as many lambs at 27*s.* each, and three times as many pigs at 11*s.* each. How many more pigs than lambs will he buy?

4. Write the English Table of Money. Why is 1*q.* sometimes written thus ¼*d.*? if 1*d.* were expressed in the same way in terms of 1*s.*, how would it be written?

Reduce each of the following to farthings, and explain clearly the reason of the steps: (1) 17*s.* 7*d.* (2) £1. 9*s.* 11¾*d.* (3) 5 guineas. (4) £7. 0*s.* 6¼*d.*

5. (*a*) *A* has 41 lambs, *B* has 47 more than *A*; if *C* had 11 more than he have, he would have twice as many as *A* and *B*. If *A*'s lambs be worth 45*s*. 6*d*. each, and *C*'s 38*s*. 9*d*. each, and if *A* and *C* exchange their flocks, what sum of money ought to pass between them? A /c £ 385 5 9

(*b*) 365 pecks of potatoes cost £34. 11*s*. 11¾*d*. Find the value of 25 pecks. £2 7s 4¾d

XX.

1. (*a*) 1 dozen = 12; how many more bottles are there in 17 dozen and 7 than in 7 dozen and 17?

(*b*) Of 12 ears of corn, 4 had 36 grains each, 6 had 65 each, the rest 100 each; how many grains were there in all?

2. (*a*) Johnson's farm, which contains 588 ac., = 6 times Osborn's, Johnson's and Osborn's together = 14 times Baines'. How many acres are there in the 3 farms?

(*b*) Divide 60294950 by 720, and also by its factors 8, 9, and 10, and shew that the results agree.

3. What is Reduction?

(*a*) In 506530 farthings (1) how many sovereigns, &c. (2) how many guineas, &c.?

(*b*) In 84906 half-crowns (1) how many guineas, &c. (2) how many fourpenny pieces?

(*c*) Reduce 18$, 5 cents to mills, it being given that 1 dollar ($) American money = 10 dimes = 100 cents = 1000 mills.

4. (*a*) What change out of a £100 bank note ought I to receive, after paying my grocer £11. 16*s*. 11¼*d*., wine merchant 16 guineas, bookseller £9. 0*s*. 9½*d*., tailor £30. 15*s*. 0¾*d*., and brewer £17. 10*s*. 7*d*.? Explain each step of the operation.

(*b*) I start with £25; what shall I have left if I give to each of 17 people 3*s*. 8¼*d*., and to each of 23 others 15*s*. 0¾*d*.?

(*c*) Multiply 12$, 7 cents (1) by 11, (2) by 56, (3) by 200.

5. (*a*) A yacht and its fittings cost £1005. 12*s*., the yacht costing 5 times as much as the fittings; by how much did the cost of the yacht exceed that of the fittings?

(*b*) To every 2 sheep in the flock there are on the average 3 lambs; the owner values his whole flock at £871. 4*s*., putting each sheep at £3. 4*s*., and each lamb at £1. 18*s*. Find the number of lambs, and the difference in the total value of the sheep and lambs.

X

XXI.

1. (*a*) Apply the Rules of Reduction to the following Ex. A person has £17. 8*s.* 6*d.*; how much has he left, after paying away £1. 6*s.* 10½*d.*, £3. 2*s.* 8*d.*, 4½ guineas, 14*s.* 7½*d.*, and £1. 0*s.* 9¾*d.*?

(*b*) A dealer bought 9 oxen at £11. 17*s.* 8*d.* each; one died, and the others he sold at a profit on each of £2. 2*s.* 2½*d.* Find his gain.

2. Write down the tables for Troy and Avoirdupois weight. What are they respectively used for?

(*a*) A goldsmith manufactured 2 lbs. 3 dwts. 8 grs. of gold into rings, each containing 9dwts. 16grs.; he sold the rings at £2. 10*s.* each: how much did he receive for them?

(*b*) I sold a horse for 136$, 7 cents, which is 27$, 69 cents more than he cost me. What did he cost me?

(*c*) The value of a mark being 13*s.* 4*d.*, and that of a moidore 27*s.*, shew that there are twice as many farthings in 57 marks and 57 moidores, as there are drs. in 1cwt. 3qrs. 19lbs. 8oz. 8drs. of sugar.

3. (*a*) If 3 men do as much work in a given time as 7 boys, (1) what number of men will do the same amount of work as 9 men and 14 boys? (2) what number of boys?

(*b*) Write down the quo^t. and the rem^r. of 508034÷(1st) by 100, and (2nd) by 100000. Divide 6008570 by 573000, cutting off the cyphers from the divisor.

4. (*a*) 1 franc (fr.) (French money) being = 100 centimes = 9¾*d.* English money, convert (1) £26 into French money, (2) 200fr. 5c. into centimes.

(*b*) A man was engaged to work 36 days, on condition that he should receive 2*s.* 6*d.* for each day he worked, and pay his employer 1*s.* 6*d.* for each day he was idle: at the end of the time he received £3. 2*s.* How many days was he idle?

5. (*a*) The product of two numbers, of which one is thrice the difference between ten thousand and one, *and* nine thousand and nine hundred and ninety-seven, is three hundred and twenty-three thousand seven hundred and ninety-six. Find the other number.

(*b*) A piano, table and carpet cost £63. 5*s.* 6*d.*; the piano and table cost £54. 14*s.* 9*d.*, and the table and carpet cost £26. 0*s.* 4*d.* Find the price of each.

XXII.

1. Write down a prime and also a composite number. State how prime numbers differ from composite numbers.

(*a*) What number added to 70 times 345 will make a sum total of 70 thousand?

(*b*) The sum of the ages of two sisters is 71 yrs., and one is (in 1866) 19 yrs. older than the other. How many yrs. will elapse before the younger is twice as old as the elder now is?

2. Shew that ½ of any number × 2 = the number.

(*a*) A grocer buys 183 lbs. of sugar for 700*d.*; he puts aside 33 lbs. of it for his own use. At what price per lb. must he sell the remainder, in order to gain one-half of his outlay?

(*b*) The weekly wages of 6 men and 5 women amount to £5. 12*s.*; each man receives one-half as much more as each woman; find the daily wages of a woman.

3. Write down the table for Apothecaries' weight. How many lbs. Avoird. are there in general in 1 stone? How many lbs. in 1 stone of meat? How many lbs. in a firkin of butter? How many grains Troy in 1 lb. Avoird.?

(*a*) A person having 13 barrels of tobacco, the tobacco in each weighing 7 cwt. 24 lbs., wishes to put it into the same number of boxes of different sizes, the 1st size containing 48 lbs., the 2nd 35 lbs., and the 3rd 18 lbs.; how many of such boxes must he obtain?

(*b*) He buys the tobacco at 21 guin^s. a cwt.; and retails it 3½*d.* an oz.; what will be his profit, supposing the carriage on each cask to be 7*s.* 3*d.*, and the waste of tobacco to be 27 lbs.?

4. (*a*) How many more francs than dollars are there in £325, 1 dollar being = 4*s.* 2*d.*, and 1 franc = 9¾*d.*?

(*b*) A farmer sold 27 firkins of butter at 11¾*d.* a lb., and received in payment £4. 0*s.* 6*d.* in money, and 12 boxes of tea, each containing 35 lbs.; find the price of the tea per lb.

Explain clearly each step of the working of (*b*).

5. (*a*) What is the tax upon 500 guin^s., when £957. 12*s.* 6*d.* is rated at £23. 18*s.* 9¾*d.*?

(*b*) How many grains of quinine are there in 47 packets, each containing 1 lb. 7 oz.?

(*c*) Write down the number of dollars, &c. there are in 50302 mils. (2) How many centimes are there in 241 fr. 7 c.?

XXIII.

1. Define numeration.

(*a*) In the year 1865 thirty thousand nine hundred and twenty-six persons arrived in the Colony of Victoria, twenty-five thousand two hundred and ninety-two persons left it, twenty-five thousand eight hundred and eleven children were born, and ten thousand four hundred and sixty-six persons died; the population at the end of the year was six hundred and twenty-six thousand five hundred and thirty. What was the population at the beginning of the year?

(*b*) A man travelled 1056 miles; 275 of which distance he went by railway (1st class), then double that distance by steam boat, and the remainder of the journey by railway (3rd class); the railway fares were 1st class 2¼*d.* a mi., 3rd class 1¾*d.* a mi., the steam boat fare was 2*d.* a mi.: he had allowed himself for travelling expenses £12; was that too much or too little? How much?

2. (*a*) Add together 4840, 478, and 982; divide the sum by 140; from the quotient subtract 18; and multiply the remainder by 409.

Explain fully each step in the process of division and multiplication.

(*b*) A lady having three farms, one of 840 acres, one of 62 acres, and one of 1146 acres, wishes to divide them among her seven sons, giving each of the younger sons an equal share, and the eldest son a double share; find the number of acres in each son's portion.

3. Write down the tables of Linear and Cloth measure.

(*a*) Shew that there are 13 times as many inches in 14 mi. 4 fur. 11 po. 1 ft. 10 in., as there are ounces in 1 ton 19 cwt. 2 qrs. 8 lbs. 8 oz.

(*b*) A draper sold to one lady 27 yds. 3 nls., and to another 3 yds. 1 in. of a piece of cloth 100 yds. in length; by how much did the part left exceed the part sold?

4. (*a*) Mr Johnson owes Mr Mould £5. 16*s.* 3*d.* for oats, £35. 7*s.* 9¾*d.* for malt, £34. 19*s.* 0½*d.* for wheat, and £29. 0*s.* 11¼*d.* for hay; and Mr Mould owes Mr Johnson eight guineas for pigs, £22. 16*s.* 7*d.* for barley, and £45. 12*s.* 11*d.* for bullocks; which of them ought to receive money from the other, and how much, in order to settle their accounts?

(*b*) Multiply (1) 25 half-guineas by 29; (2) divide £16501. 8*s.* 4¼*d.* by 197. Prove the truth of each result.

5. (*a*) A person, whose income is £900, pays £15 for income tax; how much is the tax in the £?

(*b*) A person's income is reduced by income tax from 1500 fr. 75 c. to 1440 fr. 72 c. Find the income tax in the franc.

(*c*) 18 rupees, 9 half-crowns, and 17 three penny pieces amount to £2. 16*s*.; find the value of a rupee. 1 lac = 100000 rupees. Find the value of a lac in English money.

XXIV.

1. (*a*) Write down in words the number which multiplied by 420 will give the continued product 68003, 4002, and 7070.

(*b*) *A* and *B* having an equal share in a heap of potatoes, containing 86 bus.; *A* takes 24 bus., and *B* the rest, paying *A* £2. 15*s*. 5*d*.: what is the worth of a bushel of potatoes?

2. (*a*) A tradesman made the three following errors in a bill: he copied £7. 0*s*. 6*d*. for 7*s*. 6*d*., £8 for 18 guineas, and in adding up the bill, made it amount, as copied, to 5*s*. less than the correct sum; how much less was the person, to whom the bill was sent, charged than he ought to have been?

(*b*) 6 curtains take 64 yds. of damask, at 4*s*. 3*d*. a yd. Find the cost of each curtain?

(*c*) A farmer gave £21. 18*s*. 8*d*. for 14 sheep; 3 of them died; at what rate per head must he sell the rest, in order to gain £1. 18*s*. by his bargain?

3. (*a*) In standard gold how many parts are pure gold? How many lbs. &c. Troy are there in 55 lbs. Avoird.?

(*b*) Seven trucks of coals weigh 31 tons 3 cwt. 3 qrs. 6 lbs.; two of them weigh 7 tons 17 cwt. 2 qrs. 18½ lbs. Find the average weight of each of the others.

(*c*) A person gives a £5 note to pay the following bill:—3½ cwt. of coals at 10½*d*. a cwt., 13 lbs. of cheese at 7¾*d*. a lb., 2¾ lbs. of tea at 3*s*. 3*d*. a lb., 17 lbs. of sugar at 5½*d*. a lb., 8½ yds. of flannel at 1*s*. 11½*d*. a yd., and 29 yds. of calico at 10¾*d*. a yd. What change should he receive?

4. (*a*) If 12 bullocks can plough 11 ac. in 5 days, how long ought 5 horses to take to plough 33 ac., it being given that 1 horse can do as much work in a given time as 2 bullocks?

(*b*) Supposing unity to be represented by 3¾*d*., find the value of forty millions five thousand and six.

5. (*a*) Divide 270 guin^s^. into an equal number of guin^s^., half guin^s^., crowns, half crowns, shillings, and sixpences.

(*b*) £28. 4*s*. is divided among 18 men, and a certain number of women: each man has £1. 3*s*. 6*d*., and each woman 15*s*. 8*d*. Find the number of women.

(*c*) The debts of a bankrupt are £3560, and his assets are £1349. 16*s*. 8*d*. What will his creditors lose on each £?

Explain clearly each step in the last 3 Examples.

XXV.

1. (*a*) Shew that the same result is obtained whether you divide any number by 5, or multiply it by 2 and then divide the product by 10: take as Ex^s^. 7035÷by 5, and 206501÷5.

(*b*) *A*, *B*, and *C* start on a tour; *A* takes 256 fr. 15 c., *B* 27 fr. more than 4 times as much as *A*, *C* 3 times as much as *A* and *B* together less 140 fr. 9 c. How much more money has *C* than *B*?

2. (*a*) I am sent to my grocer's with 5*s*. to buy 3 oz. of tea at 3½*d*. an oz., 12 oz. of coffee at 1*s*. 8*d*. a lb., 1½ lb. of sugar at 5½*d*. a lb., ½lb. of butter at 17*d*. a lb. What change ought I to bring back?

How many yds.=1 mile? How many yds.=1 chain? How many links=1 chain? How many inches=1 hand?

(*b*) At a circus there were 22 horses, and each went 16 rounds, the circle being 120 ft. round; find (1) how many yds. in all they ran, (2) how many chains, (3) how many miles.

3. (*a*) Divide £59. 6*s*. 3¾*d*. among 15 people, giving each of 4 of them twice as much as each of the others.

(*b*) Divide £59. 6*s*. 3¾*d*. by £3. 2*s*. 5¼*d*. Explain the result.

4. What is the difference between a lin^r^. yd., a sq. yd., and a cub. yd.? Write down the tables for square and cubic measure.

(*a*) Shew that there are six times as many grains in 12 lbs. 13 dwts. 18 grs. of silver, as there are oz. in 6 cwt. 1 qr. 23 lbs. 7 oz. of sugar.

(*b*) A man walked 111½ mi. in 26 hrs.; he walked 5 mi. 26 po. the first hr., and 3 m. 1 fur. 6 po. the last hr.; find his average pace of walking per hr. during the rest of the time.

5. (*a*) A grocer's bill amounts to £189. 15*s*. It happens to be made up of equal sums for tea at 3*s*. 10*d*. a lb., sugar at 6*d*. a lb., rice at 4½*d*. a lb., and coffee at 1*s*. 3*d*. a lb. How many lbs. are there of each sort?

(*b*) *A* owes £2880; he has £211. 6*s*. 8*d*. in money, £675. 11*s*. 10*d*. in good debts, and £109 in debts on which he will receive 3*s*. 6*d*. in the £. How much can he pay in the £?

XXVI.

1. (*a*) Harry and John are on opposite sides of a ladder, which has 57 steps. Harry's feet are on the 21st step from the top, and John's on the 21st step from the bottom. When one goes *up* a certain number of steps, the other goes *down* the same number, and *vice versâ*. Harry goes up 15 steps, then up 3, then down 9, then up 7, then down 24. After all this pacing up and down, how many steps will there be between their feet?

(*b*) What number, subtracted 88 times from eighty thousand and five, will leave 13 as a remainder?

2. (*a*) A postman sells 127 stamps daily, 15 of which are sixpenny, 27 fourpenny, 17 twopenny, and the rest penny stamps. How much money does he take in 1 week of 6 days? How much in 52 of such weeks?

(*b*) A tax collector took at one house 3*s*. 9*d*.; at a 2nd £2. 0*s*. 1½*d*.; at a 3rd 11*s*. 7*d*.; at a 4th £7. 6*s*. 8*d*.; at a 5th £1. 17*s*. 4½*d*.; at a 6th as much as he had taken at the 1st three houses less 1*s*. 7*d*.; his pocket burst and all the money he had collected was scattered on the ground; he picked up £13. 16*s*. 5¾*d*.; did he lose any money? if so, how much?

3. Write down the tables for wine and beer measure.

(*a*) Shew that there are 5 times as many pts. in 3 pipes. 1 hhd. 29 gals. of wine, as there are gals. in 3 tuns, 1 hhd. 50 gals. of beer.

(*b*) A woman is allowed 1½*d*. a score for selling eggs, ¾*d*. a lb. for selling butter, and 3½*d*. a dozen for selling pigeons; if she sell 5 score of eggs, and 17 lbs. of butter, how many pigeons must she sell to make her earnings amount to 3*s*.?

4. Calculate the following bills:

(*a*) 5½ stone of flour at 2*s*. 8*d*. a st., 8½ lbs. of cheese at 8*d*. a lb., 11¼ lbs. of butter at 1*s*. 7*d*. a lb., 2¼ lbs. of tea at 3*s*. 4*d*. a lb., 5½ lbs. of coffee at 1*s*. 5*d*. a lb., 19¾ lbs. of pork at 9*d*. a lb.

(*b*) 9 lbs. of tea at 85 cents a lb., 17 lbs. of coffee at 16½ cents a lb., 37 boxes of raisins at 2 dollars, 75 cents a box, 57 gals. of oil at 1 dollar, 7 cents a gal., 73 lbs. of rice at 4 cents a lb.

5. (*a*) Divide £5. 16*s*. 10½*d*. between *A*, *B*, and *C*; so that for every 5*d*. which *A* receives, *B* may receive 6*d*., and *C* half as much more as *A* and *B* together receive.

(*b*) If 7 men can build a wall in 16 days, how many men can build a wall 3 times as long in half the time?

XXVII.

1. (*a*) A merchant bought 960 lbs. of cheese at 79 c. a lb., 147 lbs. of butter at 1 fr. 5 c. a lb. He gave in payment 13 yds. of cloth at 5 fr. 15 c. a yd., 3 casks of sugar, each containing 126 lbs., at 45 c. a lb., and the remainder in cash; how much had he to pay in francs and centimes?

(*b*) How long will an 18 gal. cask of beer last, if it be used at the rate of 4½ pts. daily?

2. Write down the tables of dry measure, and time.

(*a*) Shew that there are 3 times as many sq. ft. in 17 ac. 3 ro. 37 po. 20¾ sq. yds. 6 sq. ft., as there are pts. in 604 hhds. 28 gals. of beer.

(*b*) I was to give for half a dozen hoggetts either £19. 16*s*., or 13 pigs and 2 qrs. of peas. Find the price of peas per qr., it being given that 11 pigs are worth as much as 4 hoggetts.

3. How many sq. links, and also how many sq. yds. are there in 1 ac.? how many ac. in 1 sq. mi.?

(*a*) A person bought 8 ac. 1 ro. 6 po. at £56 an ac., and 18 ac. 2 ro. 33 po. at £52 an ac.; the cost of the timber was £60 in addition. Find the amount of the whole purchase.

(*b*) A bankrupt pays 12*s*. 6*d*. in the £; his debts amount to £2345. 6*s*. 8*d*.; what are his effects worth?

4. (*a*) Shew that the same result is obtained, whether you divide a given number by 225, or multiply it by 4 and then divide the product by 900. Take 75617 ÷ 225 as an Ex.

(*b*) 273541 × by 8, and the product ÷ by 1000 gives the same result as would have been obtained by dividing by a certain number. Use the prime factors, of which the required number is made up, to shew the truth of the statement.

5. (*a*) A field of 42 ac. is reaped partly by 6 men, who each cut half an acre a day, and partly by a machine which cuts 4 ac. a day; how much less time will be taken in reaping the field than (1) if the men alone had worked, (2) if the machine alone had worked?

(*b*) If soldiers on slow march, on an average, take 85 paces of 33 in. each in a minute, how long will it take them to march 25½ mi.?

XXVIII.

1. (*a*) Write in Arabic figures, and also in words the meaning of CCCXLVII, MMDCXXIX, and MMMCCCIV.

(*b*) There are two numbers, the greater of which is 73 times 109, and their difference is 17 times 28; find the less number.

2. (*a*) A manufacturer, having £4. 10*s*. in his purse, distributed all of it but 4*s*. 6½*d*. among his work people, giving each man 18*d*., each woman 1*s*., and each boy 9½*d*.; there were 7 more men than women, and as many boys as men and women taken together; find the number of boys.

(*b*) 3 fields, of which the 2nd is twice the size of the 1st, and the 3rd three times the size of the 2nd, contain 113 ac., 3 ro. 25 po.; find the size of each field.

(*c*) An innkeeper buys 2 hhds. of beer for 4 guineas, and sells it out at 2¼*d*. a pint; find his gain.

3. Write out the table of Number. How is leap-year determined?

(*a*) Did the 1st two months of 1865 contain more or less seconds than the last two months of that year? How many?

(*b*) An edition of a book requires 10 reams, 16 quires, 5 sheets of paper; find the number of sheets.

(*c*) A boy trundles his hoop, the outer rim of which is 5 ft. 6 in., from Glaston to Uppingham (1¾ mi.) without letting it fall; how many turns did the hoop take?

4. (*a*) *A*, *B*, *C*, and *D*, went on a fishing excursion, it being agreed that *A* and *D* should each pay the same share of the total expenses, that *B* should pay half as much again as *A*, and *C* half as much again as *B*. *A* paid the travelling expenses of the party, which amounted to £2. 13*s*. 10*d*.; *B* the hotel expenses, which amounted to £3. 0*s*. 5½*d*.; and *C* paid 15*s*. 1*d*. for casual expenses. *D* settles his account with *A*. How should *C* settle his account?

(*b*) A grocer bought 40 lbs. of tea at 3*s*. 6*d*. a lb., and also some cheaper tea; he mixes the tea, and by selling all the tea for £23. 12*s*. 6*d*., at 3*s*. 4½*d*. a lb., gains £3. 5*s*. 10*d*. on his outlay; how many lbs. of the cheaper tea did he buy, and at what price per lb.?

5. (*a*) A market woman charged £1. 17*s*. 6*d*. for 3 geese and 5 pairs of chickens, whereas the price of a single goose and a single chicken would have been 8*s*. 5*d*. How much did the price of a goose exceed that of a chicken?

(*b*) 7 men can complete a piece of work in 15 days; find the time in which 5 men and 6 boys ought to complete a piece of work of the same nature 3 times as great, it being given that 2 men can do as much work in a given time as 3 boys.

XXIX.

1. (*a*) Last year (1865) three hundred and sixty-five millions of eggs were imported into Great Britain: if the value of 120 eggs be 6*s*., find the value of the imported eggs.

(*b*) A person enters France with £35. 4*s*., which he converts into French money, at the rate of 25 fr. 35 c. for £1; what French money ought he to receive?

2. (*a*) Find the amount of the foll^{g}. bill: 12½ tons of hay at £3. 15*s*. a ton, 8¼ qrs. of beans at 2 guin^{s}. a qr., 11¾ qrs. of oats at £1. 6*s*. a qr., and 5 sacks of flour at 27*s*. 6*d*. a sack.

(*b*) If from home to school and back again be ¾ mi., and a boy is 20 min. in walking this distance, how far will he have walked while attending school twice a day for 240 days, and how many hours will he have spent in walking?

(*c*) Reduce 17 po. 4 yds. 2 ft. 9 in. to in. Prove the truth of the result.

3. Explain how the ten digits may be made to represent any number however large.

(*a*) There are two numbers, whose difference is 45, and whose sum exceeds 400 by 55; find their product. Explain clearly each step of the multiplication.

(*b*) (1) How many times can the difference between one million and one thousand be subtracted from five thousand and sixty-six millions seven thousand and nineteen? (2) What number must be added to this latter number so that the above difference may be subtracted just once more?

4. (*a*) A person exchanged 18 dozens of wine for a gold snuff box weighing 8 oz. 13 dwts. 10 grs. valued at £4. 10*s*. an oz. What did he value his wine at per dozen?

(*b*) How many dresses can be trimmed with 37 pieces of braid, each measuring 17 yds., if each dress require 13 ells, 2 yds.?

5. (*a*) If 6 hats cost as much as 25 pairs of gloves, worth 3*s.* 3*d.* a pair, how many hats can be bought for £61. 12*s.* 3½*d.*?

(*b*) Of a farm containing 300 ac., two lots were reserved, one containing 57 ac. 2 ro. 36 po., and the other 24 ac. 20 po.; the remainder sold at £68 per ac.; how much did it bring?

XXX.

1. (*a*) One side of a square field is 20 chains 6¼ lks.; what is the distance round the field in yds., ft., and in.?

(*b*) How many inches taller is a horse of 15½ hands, than a pony of 13¾ hands?

2. (*a*) Shew that there are as many cub. in. in the sum of 3 times 5 cub. yds. 2 cub. ft. 48 cub. in. and 6 times 3 cub. yds. 1468 cub. in., as there are lin^{r}. in. in 24 mi. 1064 yds. 2 ft.

(*b*) In a cricket match, the score on one side in the 1st innings was 165, and it was made up thus; each of 5 players scored the same number of runs; each of 2 others scored 11 more runs than each of the 5; each of 2 others scored 6 runs less than each of the 2 just mentioned; 1 scored 35, and 1 made no score; the byes, &c. scored 17. Find the number of runs scored by each of the players.

3. (*a*) There is a certain number, which being divided by 3, the quotient multiplied by 4, and 16 added to the product, will give 64; find the number.

(*b*) How many women are equivalent to 6 men, 13 women and 27 children, it being given that 1 man = 2 women, and 1 woman = 3 children?

How many lbs. of bread would each child receive, if I divided fifty-one 4 lb. loaves among the above, as directed by the question?

4. (*a*) 9*d.* a head was allowed for each of the 78 boys, and 7½*d.* a head for each of the girls to defray the expenses of a school treat, which were as follows: 4 stones of plum cake at 5*s.* 6*d.* a stone, 4 stones of bread at 2*s.* 6*d.* a stone, 8½ lbs. of butter at 17½*d.* a lb., 7 lbs. of sugar at 5*d.* a lb., 2¼ lbs. of tea at 3*s.* 4*d.* a lb., 208 buns at 13 a shilling, toys and prizes £2. 18*s.* 11¼*d.* Find the number of girls.

(*b*) A boy was born at 6 o'clock p. m. on the 20th of Oct. 1863; how many minutes has he lived up to the present time 10 hr. 19 min. a. m. July 10, 1866?

5. Work by Practice,

(*a*) The value of 6043 lbs. of tea at 3*s*. 2½*d*. a lb.

(*b*) If sugar be bought at £1. 19*s*. 6*d*. a cwt., and retailed at 6½*d*. a lb., what is the profit on a cask containing 7 cwt. 1 qr. 14 lbs.?

XXXI.

1. Shew that any number is divisible by 8, if the number expressed by its three right hand figures is divisible by 8.

(*a*) *A* has 19*s*. 8½*d*., and *B* has 17*s*. 11*d*.; *A* gives *B* 7*s*. 10¾*d*., and *B* gives *A* 13*s*. 9½*d*. Which has the most money, and by how much?

(*b*) A man's income is £500 a year; how much may he spend per day on an average to save £25. 10*s*. per annum?

2. (*a*) A Fenian prisoner escaped, and travelled at the rate of 128 mi. a day; 3 days afterwards a policeman starts after him, and goes exactly the same route at the rate of 224 mi. a day. How many days will the prisoner have been at liberty before he is caught?

(*b*) If a labourer's family spend 10*s*. 6*d*. a week for bread and meat, and always use 3 stone of bread weekly, how much meat may they allow themselves when bread is 2*s*. 6*d*. a stone, and meat 9*d*. a lb.? and how much when bread is 3*s*. a stone, and meat 8*d*. a lb.?

3. (*a*) Find the cost of 35 dozen of wine at 35*d*. a bottle; if 9 bottles be spoiled, and the remainder be sold at the rate of £2. 7*s*. a dozen, find the profit.

(*b*) Shew that there are 3 times as many sq. ft. in 17 ac. 3 ro. 37 po. 20¾ sq. yds. 6 sq. ft., as there are pints in 604 hhds. 28 gals. of beer.

(*c*) How many houses, each with a frontage of 10 yds. 3 ft., can be built on a terrace 752 yds. 2 ft. in length, allowing for a roadway at each end of 14 ft., and a space of 7 ft. 3 in. between every two houses?

4. (*a*) A workman's wages are at the rate of 15*s*. a week, but during 14 wks. he is unable to work at all; during 7 wks. he is able to work only half time; during 5 wks. only 1 day per wk.: how much will he have earned in the year?

(*b*) If the poor rate paid on a house rated at 60 guineas be £2. 8*s*. 6$\frac{3}{4}$*d*., what amount of poor rate ought to be paid on a farm rated at £272?

5. What is 'Practice'? How many kinds of Practice are there? How do they differ?

Work, by Practice,

(*a*) A bankrupt's debts amount to £3548. 6*s*. 8*d*.; what will his creditors lose, if he pays 12*s*. 10$\frac{1}{2}$*d*. in the £?

(*b*) Find the value of a crop on 12 ac. 1 ro. 22 po. at £19. 6*s*. 8*d*. an ac.

XXXII.

1. (*a*) Double the sum of two numbers is twenty-five thousand two hundred and eighty, and half their difference is eight hundred and four: find the numbers.

(*b*) Divide £177 among 15 men, 20 women, and 30 children, so that a man and a child may receive as much as 2 women, and all the women may receive £60.

2. Why would it be absurd to ask a boy to multiply £1. 10*s*. by 6*s*.? Would it be absurd to ask him to divide £1. 10*s*. by 6*s*. Why?

(*a*) The produce of a farm, viz. 964 bus. 3 pks. 1 qt. of grain, is to be divided among 3 men in proportion to the rent they each pay. The first pays $\frac{1}{2}$ the rent, the 2nd $\frac{1}{3}$rd of the remainder, and the 3rd what then remains. How much of the produce will each man have?

(*b*) *A* and *B* are travelling the same road in the same direction; they are 1 mi. 4 fur. 20 po. apart, and *B* gains 8 po. upon *A* in every 25 po.; how far must *B* travel before he overtakes *A*?

3. (*a*) If 1 lb. of tea be equal in value to 50 oranges, and 70 oranges be worth 84 lemons, what is the value of 1 lb. of tea, when a lemon is worth a penny?

(*b*) A parish, containing 960 ac., is rated on a rental of £2040; a rate of 8*d*. in the £ is levied; what on the average is the charge per acre?

4. (*a*) A merchant buys a piece of cloth, 105 yds. in length, for which he pays 262$, 50 cents; he wishes to make a profit of 52$, 50 cents; how much must he ask for the cloth per yd.?

(*b*) Find, by Practice, the cost of making a road (1) 14 mi. 3 fur. 210 yds. in length, at £69. 13*s*. 4*d*. a mile; and (2) the cost of 5 bins of oats, each containing 7 qrs. 7 bus. 3 pks., at £1. 8*s*. 8*d*. a qr.

5. (*a*) A tenant holds a farm subject to a tax of 3*s*. 6*d*. per ac., and a corn rent of 100 qrs. of wheat, barley, oats and beans, respectively. The amount of his rent is £647. 10*s*., when the average prices of wheat, barley, oats and beans per qr. are 38*s*. 9*d*., 27*s*. 4*d*., 17*s*. 4*d*. and 33*s*. 10*d*. respectively. Find the number of acres in the farm.

(*b*) A draper sold of 50 yds. of silk, 5 yds. 2 qrs. to one lady, 17 yds. 3 nls. 1¼ in. to another, and 12 yds. 2 nls. 2 in. to a third; how much of it was left? By how much did the part sold exceed the part left?

(*c*) A farmer rents one field of 12 ac. 25 po. 16½ sq. yds. at £17. 4*s*. 3½*d*., another of 17 ac. 1 ro. 14 po. 17¼ sq. yds. at £26. 15*s*. 11*d*., and a third of 13 ac. 2 ro. 4 po. 18½ sq. yds. at £34. 17*s*. 6¼*d*. Find the average rent per acre of the three fields.

(*d*) A lady paid with 3 ten pound notes for 64 yds. of sheeting at 14½*d*. a yd., 4 pairs of blankets at 18*s*. 4*d*. a pair, 3 pairs ditto at 12*s*. a pair, a silk dress (18½ yds.) at 5*s*. 6*d*. a yd., 26 yds. of huckaback at 10¾*d*. a yd., 9 damask table cloths, 4 of them at 19*s*. 6*d*. each, the rest at £1. 6*s*. 6*d*. each, and 4 balls of string at 1*s*. 6*d*. for a dozen balls, and received the change in farthings, three-penny pieces, four-penny pieces and sixpences, the same number of each. How many of each did she receive?

XXXIII.

1. (*a*) If the divisor, dividend and quotient be 216, 435780 and 2017, respectively, what is the remainder?

(*b*) In the year 1865, 1450238 sovereigns, 1834750 half-sovereigns, 1580040 florins, 5619240 shillings, 1631520 sixpences, 4158 fourpences, 1746888 threepences, 4752 silver twopences, 7920 silver pence, 8601600 bronze pence, 8064000 halfpence, and 4659200 farthings were coined at the Mint. Find the total value in £s, shillings, and pence.

2. (*a*) After deducting 4*d*. in the £ for income tax, a person's net income was £848. 12*s*. 4*d*.; what was his gross income?

(*b*) Bought 27 pieces of flannel for £70. 17*s*. 6*d*. at the rate of 2*s*. 2½*d*. per English ell; how many yards did each piece contain?

3. (*a*) What is an aliquot part of a number? Find, by Practice, (1) the value of 1 pipe, 47 gal. 1 qt. of wine at £28. 17*s*. 6*d*. a hhd. (2) the value of 2037½ cwt. of sugar at £1. 19*s*. 8½*d*. a cwt.

(*b*) Two thieves, *A* and *B*, divide 17 silver cups, each weighing 10½ oz., 2 doz. and 9 silver forks, each weighing 2 oz. 8 dwts., and 43 silver spoons, each weighing 3 oz. 18 grs. between them, *A* taking half as much again as *B*; what is the value of *A*'s share at 6*s*. 8*d*. an oz.?

4. (*a*) *A*, *B*, *C* and *D* dine at an hotel, *B* and *C* are each to pay one-third less than *A*, and *D* is to pay one-third more than *A*; the bill amounts to £5. 6*s*. 4*d*.; how are they to divide it?

(*b*) Divide two fields, one of 6 ac. 3 po. 13 sq. yds., the other of 4 ac. 37 po. 27 yds., between *A*, *B* and *C*, so that *A*'s no. of ro. = *B*'s no. of po. = *C*'s no. of yds.

5. (*a*) If £23. 0*s*. 3¾*d*. pay the carriage of 15 tons, 16 cwt. 11 lbs. of goods for 240 miles, what weight should be carried 180 miles for the same sum?

(*b*) If 24 oxen require 6 acres of turnips to supply them for 10 weeks, how many acres would supply 6 score of sheep for 15 weeks, on the supposition that 3 oxen eat as much as 10 sheep?

6. (*a*) A train, consisting of 3 first, 4 second, and 5 third class carriages, travelled from York to London, a distance of 191 miles. The rates charged per mile were 1st class, 2¼*d*.; 2nd class, 1¾*d*.; 3rd class, 1*d*.; the amount paid by the passengers was £465. 19*s*. 2½*d*.; the number of passengers each 2nd class and each 3rd class carriage contained was 32 and 48 respectively. Find the number of passengers in each 1st class carriage.

(*b*) The average yearly quantity of coal raised in the United Kingdom from 1855 to 1862 (both inclusive) was 71974737 tons, 10 cwt.; 61453079 tons were raised in 1855, and 8629215 tons in 1863. What average yearly quantity of coal was raised from 1856 to 1863 (both inclusive)?

EXAMINATION PAPERS.

PART III.

PAPERS (XXXIV—XXXIX) ON VULGAR FRACTIONS.

XXXIV.

1. Define a Multiple of a given number, a Common Multiple of two or more numbers, the Least Common Multiple of two or more numbers.

(*a*) Find the L. C. M. of 3, 4, 10, 14, 21 and 35.

(*b*) What is the smallest sum of money, with which I can purchase either pigs at 16*s*. each, lambs at £2 each, calves at £5. each, or cows at £8. 5*s*. each?

2. Define a fraction. If you increase the den^r. of a fraction, how is its value affected? Why?

(*a*) Convert $\frac{872}{16}$ into a mixed number, and $12\frac{3}{8}$ into a fraction with a den^r. 56.

(*b*) (1) Compare the values of $\frac{3}{4}$, $1\frac{2}{3}$, $\frac{1}{2}$ of $\frac{4}{5}$, 1, and $\frac{1}{8}$ of $\frac{1}{4}$ of $1\frac{1}{10}$.

(2) Reduce $\frac{172}{1118}$ and $\frac{1540}{3465}$ each to its lowest terms.

3. How do you shew that $\frac{1}{2}+\frac{3}{4}=1\frac{1}{4}$?

Simplify:

(1) $\frac{84}{280}+\frac{9}{70}+\frac{1}{4}+\frac{8}{42}$.

(2) $3\frac{5}{6}-1\frac{8}{9}$.

(3) $7\frac{3}{4}-4\frac{5}{12}-\frac{2}{21}+1\frac{3}{28}$.

(4) $\frac{3}{4}$ of $2\frac{1}{2}\times 11\frac{3}{10}$.

(5) $\frac{3}{4}$ of $2\frac{1}{3}\div 11\frac{3}{10}$.

(6) $\frac{3}{4}\div 2\frac{1}{2}\times 11\frac{3}{10}$.

4. (*a*) What number added to the sum of $\frac{7}{8}$, $1\frac{7}{12}$, $10\frac{5}{8}$ and 5 will make the sum total $=20$?

(*b*) From a cask containing $41\frac{1}{2}$ gal^s., $17\frac{5}{8}$ gal^s. are drawn off; by how much does the part left exceed the part taken?

5. (*a*) Wheat is 7*s*. 6*d*. a bus.; what will $\frac{5}{6}$ bus. cost?

(*b*) A clergyman gave 15 tons of coals among his poor, giving each $1\frac{2}{3}$ cwt.; among how many persons did he divide it?

(*c*) Oats are worth $\frac{5}{8}$ of 7*s*. 6*d*. a bus., and hay £3. 10*s*. a ton; how many bus. of oats ought to be given for $2\frac{1}{2}$ tons of hay?

6. (*a*) What part of 6*s*. 9*d*. is 2*s*. 3*d*.? Reduce $\frac{7}{16}$ of $2\frac{1}{2}$ yards to the fraction of a pole.

(*b*) *A* owned $\frac{2}{5}$ of a farm of 300 ac., he sold $\frac{2}{3}$ of his share to *B*, and *B* sold $\frac{1}{4}$ of his share to *C*: what is the value of *C*'s land, at £50 an acre?

XXXV.

1. Define a measure of a number, a Common Measure of two or more numbers, the Greatest Common Measure of two or more numbers.

Find the G. C. M. of (1) 216 and 288; (2) of 825 and 960; (3) of 680 and 3095; (4) of 700, 1080 and 1595.

2. How many kinds of Vulgar Fractions are there? Give an example of each kind. Shew that $\frac{5}{6}\times 5=\frac{25}{6}$, and that $\frac{5}{6}\div 3=\frac{5}{18}$.

(*a*) Write in figures (1) sixty-one eighty-sixths; (2) 47 in the form of a fraction; (3) 47 as a fraction with 11 for den^r.

(*b*) Reduce to simple fractions:

(1) $5\frac{1}{2}$ of 4 of $2\frac{8}{11}$. (2) 19 of $15\frac{5}{8}$ of 16. (3) $\dfrac{2\frac{1}{2}}{1\frac{1}{3}}$.

(4) $\dfrac{14\frac{2}{7}}{1\frac{1}{3}\text{ of }2\frac{2}{7}}$. (5) $\dfrac{\frac{2}{3}\text{ of }\frac{3}{4}}{2}$. (6) $\dfrac{2}{\frac{2}{3}\text{ of }\frac{3}{4}}$.

3. (*a*) Compare the values of $\frac{2}{5}$, $\frac{3}{10}$, $\frac{7}{15}$ and $\frac{9}{16}$; also of $\frac{2}{5}$, $\frac{2+7}{5+15}$, $\frac{7}{15}$ and $\frac{2\times 7}{5\times 15}$; also of $1\frac{5}{12}$, $3\frac{1}{2}$, $2\frac{4}{5}$ and $\frac{2}{3}$.

(*b*) How many fifths of an orange are there in 3 oranges? in $2\frac{7}{10}$ oranges? How many two-thirds of an orange are there in 6 oranges; in $2\frac{7}{10}$ oranges? What part of an orange remains?

4. What is meant by vinculum or bracket?

(*a*) Simplify:

(1) $\frac{5600}{7555}$. (2) $3\frac{2}{3}+1\frac{1}{5}+13\frac{7}{10}+\frac{19}{20}$.

(3) $8\frac{5}{9}-5\frac{4}{15}+7\frac{1}{3}-\frac{11}{30}$. (4) $7\frac{1}{2}-3\frac{2}{3}+\frac{3}{5}-1\frac{1}{6}\times\frac{2}{5}$.

(5) $7\frac{1}{2}-\left(3\frac{2}{3}+\frac{3}{5}-1\frac{1}{6}\right)\times\frac{2}{5}$.

(6) $7\frac{1}{2}-\left(3\frac{2}{3}+\frac{3}{5}\right)-1\frac{1}{6}\times\frac{2}{5}$. (7) $\dfrac{2+\frac{2}{3}}{2-\frac{2}{3}}\div\dfrac{1-\frac{1}{3}}{1+\frac{1}{3}}$.

5. (*a*) What fraction must be added to the sum of $31\frac{3}{8}$, $43\frac{5}{12}$ and $47\frac{5}{6}$ to make the result an integer?

(*b*) If it take $5\frac{1}{2}$ yds. of cloth for a great coat, $4\frac{1}{3}$ yds. for a dress coat, $2\frac{1}{3}$ yds. for a pair of trousers, and $\frac{7}{8}$ yd. for a waistcoat, what will be the cost of the suit, if the cloth be 12*s*. 6*d*. a yard, and the making 13*s*.? By how much does the cost of the cloth for the dress coat and trousers exceed that of the great coat and waistcoat?

(*c*) If it take $1\frac{1}{4}$ oz. of shot for a charge of a gun, how many shots can a boy have for 1 shilling's worth of shot at $2\frac{1}{4}$*d*. a lb.? How much shot will be left in his pouch after the last shot?

6. (*a*) What is the value of $\frac{78}{331}$ of 1 ton 77 lbs.? What part of $2\frac{1}{2}$ chains is 3 po. $1\frac{1}{2}$ ft.?

(*b*) If $1\frac{1}{3}$ bus. of wheat will sow $1\frac{1}{2}$ ac. of land, what will the wheat cost for 27 ac., at £3. 4*s*. 6*d*. a qr.?

(*c*) A man buys a cask of beer, containing 133 gal^{s}., for £12. 7*s*.; 5 gal^{s}. are lost by leakage; he sells the rest in jugs, each of which holds $\frac{7}{8}$ of a quart, at 6*d*. a qt.; (1) what does he charge for a jug of beer? (2) what does he gain by the bargain?

XXXVI.

1. How does the L. C. M. of two numbers differ from their G. C. M.?

(*a*) Find the G. C. M. and the L. C. M. of 216, 408 and 744.

(*b*) A farmer has 492 qrs. of wheat, 744 qrs. of barley, and 1038 qrs. of oats; he wishes to put the grain, without mixing it, into the largest possible heaps of equal size. Find the number of heaps, and the size of each.

2. When is a fraction said to be in its lowest terms? From the definition of a fraction shew that $\frac{36}{45}=\frac{4}{5}$.

(*a*) Reduce to simple fractions:

(1) $\frac{2}{3}$ of $1\frac{3}{4}$ of $\frac{4}{91}$ of $8\frac{1}{3}$ of $2\frac{3}{5}$. (2) $\frac{5577}{7909}$. (3) $\dfrac{\frac{5}{6}}{2\frac{1}{3}}$.

(4) $\dfrac{35}{3\frac{3}{14}}$. (5) $\dfrac{2\frac{4}{7}}{8\frac{1}{7}\text{ of }2\frac{1}{3}}$. (6) $\dfrac{\frac{1}{2}\text{ of }2\frac{1}{7}\text{ of }6}{30}$.

3. (*a*) Shew that $\frac{11}{13}$ is greater than $\frac{11-3}{13-3}$ and less than $\frac{11+3}{13+3}$, and that $\frac{13}{11}$ is less than $\frac{13-3}{11-3}$, and greater than $\frac{13+3}{11+3}$.

(*b*) Reduce $\frac{5}{8}$ of 4*d.* to the fractⁿ. of a guinea, and $2\frac{1}{7}$ of 5 oz. 8 grs. to the fractⁿ. (1) of 1 lb. Troy; (2) of 1 lb. Avoird.

(*c*) A person drew off from a butt of beer 52 gals. 2 qts.; what fractional part of the whole was left?

4. Shew clearly that $\frac{1}{2}+\frac{5}{6}=1\frac{1}{3}$.

(*a*) Simplify:

(1) $1\frac{4}{5}+\frac{9}{10}-\frac{13}{30}+1\frac{23}{25}$.

(2) $\frac{4}{5}$ of $6\frac{1}{4}-\frac{3}{7}$ of $14+\frac{5}{8}$ of $\frac{7}{10}$ of $2\frac{2}{7}-\frac{25}{42}$ of $\frac{12}{5}+8$.

(3) $\frac{4}{5}$ of $\left(6\frac{1}{4}-\frac{3}{7}\text{ of }14\right)+\frac{5}{8}$ of $\left(\frac{7}{10}\text{ of }2\frac{2}{7}-\frac{25}{42}\right)$ of $2\frac{2}{5}+8$.

(4) $\frac{7}{15}\div\frac{3}{20}\times\frac{11}{18}\div\frac{19}{30}\times1\frac{2}{19}\div\frac{11}{76}$.

(5) $\frac{7}{15}\div\left(\frac{3}{20}\text{ of }\frac{11}{18}\right)\times\frac{19}{30}\div1\frac{2}{19}\times\frac{11}{76}$.

(*b*) Subtract $\frac{13}{20}$ of 4 sq. po. from $\frac{4}{11}$ of an ac.

5. (*a*) How many times does the sum of $22\frac{1}{5}$ and $18\frac{4}{5}$ contain their difference?

(*b*) Divide 4 guineas between *A* and *B*, so that $\frac{1}{2}$ of *A*'s money shall $=\frac{2}{3}$ of *B*'s.

(*c*) *A* and *B* together can complete a piece of work in $1\frac{13}{55}$ days; *A* could have completed it by himself in $3\frac{2}{5}$ days; find in what time *B* can complete it? Shew that *B* can do as much work in 4 hrs. as *A* can do in 7 hrs.

XXXVII.

1. *A* can mow 2 ro. 32 po. of grass in 1 day; *B*, 2 ac. 2 ro. in $2\frac{1}{2}$ days; *C*, 2 ac. 2 ro. 32 po. in 3 days: what is the size of the smallest field which would employ each of them, working alone, an exact number of days? In what time would each mow the field? Mar. 19

2. Shew that dividing the den^r. of $\frac{5}{6}$ by 2 has the same effect as multiplying the num^r. by 2.

(*a*) Reduce $7\frac{5}{7}$ to a fraction having a den^r. 56. In $5\frac{6}{7}$ yds. how many thirty-fifths of a yd.?

(*b*) Simplify: (1) $\frac{5330}{6630}$.

(2) $2\frac{17}{19}$ of $5\frac{3}{5}$ of $\frac{18}{39}$ of $5\frac{2}{11}$ of 91 of $\frac{15}{28}$. (3) $\dfrac{\frac{1}{7}\text{ of }2\text{ of }6\frac{7}{8}}{14}$.

(4) $\dfrac{\frac{3}{4}\text{ of }5\frac{1}{2}\text{ of }\frac{1}{8}}{4\frac{1}{2}\text{ of }8\frac{1}{4}}$. (5) $\dfrac{18}{\frac{3}{7}\text{ of }\frac{4\frac{5}{9}}{12\frac{1}{3}}\text{ of }\frac{3\frac{4}{11}}{11\frac{5}{7}}}$.

3. (*a*) Find the value of

(1) $£3\frac{5}{8} - \frac{3}{7}$ of £2. 10*s.* 2*d.* $+ \frac{1}{12}$ of 14 half-crowns.

(2) $6\frac{7}{10}$ days $- \frac{9}{14}$ wk. $- \frac{3}{5}$ hr. $+ \frac{11}{15}$ mi.

(3) $10\frac{1}{25}$ of $2\frac{1}{2}$ ro. $- 3\frac{1}{9}$ of 2 ro. 33 po. $+ 1\frac{47}{73}$ of 3 ro. 26 po.

(*b*) What part (1) of a guinea is 4*s.* $4\frac{1}{2}d$? (2) of a mile is 2 fur. 118 yds. 1 ft. 7 in.? (3) of $\frac{5}{14}$ of 1 lb. avoird. is $\frac{3}{5}$ of 4 oz. 20 grs. troy?

4. How do you shew that $1\frac{1}{2} - \frac{3}{4} = \frac{3}{4}$?

(*a*) Simplify:

(1) $\{3\frac{1}{7} + 2\frac{1}{4} + 4\frac{2}{5}\} \div \left\{\frac{1}{2} + \frac{1}{3} \text{ of } \left(\frac{1}{2} - \frac{1}{7}\right)\right\}$.

(2) $\{3\frac{1}{7} + 2\frac{1}{4} + 4\frac{2}{5}\} \div \left\{\left(\frac{1}{2} + \frac{1}{3}\right) \text{ of } \left(\frac{1}{2} - \frac{1}{7}\right)\right\}$.

(3) $\{3\frac{1}{7} + 2\frac{1}{4} + 4\frac{2}{5}\} \div \left\{\frac{1}{2} + \frac{1}{3} \text{ of } \frac{1}{2} - \frac{1}{7}\right\}$.

(4) $\dfrac{6\frac{3}{4} + 3\frac{5}{8}}{7\frac{1}{2} \div \frac{5}{8}} - \dfrac{7\frac{3}{5} - 2\frac{5}{6}}{8\frac{1}{3} + 7\frac{2}{5}}$. (5) $\dfrac{4\frac{1}{2} - 3\frac{1}{3} + 5\frac{1}{12}}{7\frac{1}{2} - 4\frac{1}{3} + 11\frac{1}{12}} - \dfrac{11\frac{3}{4} - 5\frac{7}{16}}{11\frac{3}{4} + 5\frac{7}{16}}$.

5. (*a*) *A* can do a piece of work in 20 days; *B*, in 24 days; *C*, in 30 days: in what time will they do it, when they all work together? How much longer time will it take *B* and *C* than *A* and *C* to do it?

(*b*) If $\frac{1}{2}$ of *A*'s money $= \frac{4}{5}$ of *B*'s, what part of *B*'s money is equal to $\frac{2}{9}$ of *A*'s?

(*c*) A boy starts from home with a certain sum in his pocket: he pays away $\frac{5}{16}$ of it at one shop, and $\frac{5}{12}$ of what was left at another; after this he had £1. 8*s.* $10\frac{1}{2}d$. What sum did he start with?

XXXVIII.

1. Find the least number which when divided by 9, 16, 42, 63, 14, or 72 will leave a remainder 1. Mbe

2. How are fractions compared? Why must fractions be reduced to equivalent ones with a common denominator before they can be added together? 20

(*a*) Which is the greater (1) $\frac{5}{6}$ of £1, or $\frac{6}{7}$ of a guinᵃ.? (2) $1\frac{5}{9}$ of 1 ton 11 lbs., or $3\frac{2}{5}$ of 11 cwt. 6 lbs.? By how much?

(*b*) If $2\frac{1}{3}$ of $\left(A+\frac{2}{7}\text{ of }A\right)=\frac{1}{3}\text{ of }\left(B-\frac{B}{3}\right)$, find the value A in terms of B.

3. (*a*) What part of 2 sq. yds. 7 ft. is $\frac{1}{4}$ of 2 sq. yds. 5 ft.?

(*b*) Express $\frac{2}{3}$ of $\frac{6}{17}$ of £1. 14*s*. + $\frac{5}{6}$ of $\frac{1}{8}$ of £1. 10*s*. + $8\frac{1}{4}$ of $\frac{1}{11}$ of 5*s*. as the fraction of £20.

4. (*a*) How far does the sum of £13. 0*s*. $10\frac{6}{7}$*d*. £20. 19*s*. $0\frac{5}{12}$*d*., £37. 10*s*. $3\frac{8}{18}$*d*., £4. 6*s*. $5\frac{32}{35}$*d*., 11*s*. $11\frac{4}{5}$*d*. fall short of £100?

(*b*) Multiply £11. 0*s*. $6\frac{11}{24}$*d*. by $3\frac{7}{8}$, and prove the truth of the result.

(*c*) Find the value of $\left\{\dfrac{2+\frac{4}{5}}{2-\frac{4}{5}}-\dfrac{2-\frac{4}{5}}{2+\frac{4}{5}}\right\}\div\dfrac{2-\dfrac{2}{2\frac{2}{3}}}{3}$.

5. (*a*) By what fraction must $\dfrac{1\frac{1}{4}}{1\frac{1}{12}}$ of $\dfrac{2}{8}+\dfrac{2\frac{1}{2}-1\frac{5}{6}}{\frac{1}{4}+1\frac{5}{6}}-\dfrac{8\frac{1}{5}}{7\frac{4}{5}}$ be divided in order to give a quotient $=\frac{2}{3}$?

(*b*) If $\frac{4}{15}$ of an ac. produce 26 bus. of potatoes, how many pks. ought $2\frac{1}{2}$ chains to produce?

(*c*) A certain quantity of bran will last 3 rabbits or 5 guinea pigs for a week, how long ought it to last 5 rabbits and 5 guinea pigs?

XXXIX.

1. Six boys start in the same direction from the same place at the same time to go round and round a circular field, the 1st can go the round in 8 min., the 2nd in 16 min., the 3rd in 12 min., the 4th in 10 min., the 5th in 18 min., and the 6th in 6 min. When will they next meet at the place from which they start?

2. Prove that if the terms of a fractn. be multiplied or divided by the same number, the value of the fractn. is not altered.

Reduce $\frac{6}{9}$ to its lowest terms, multiply the result by $\frac{3}{4}$, divide the product by $\frac{1}{2}$. Explain each step in the solution.

(*a*) Shew that the diffce. between the prodt. and sum of $7\frac{1}{2}$ and $4\frac{2}{5}$ equals $\frac{1}{5}$ of $\frac{2}{3}$ of $\frac{25}{28}$ of $\frac{7}{10}+\frac{1}{8}$ of $2\frac{2}{3}$ of $7\frac{1}{5}$ of $2\frac{1}{12}+16\frac{1}{60}$.

(*b*) What fraction of $\frac{2}{29}$ of £3. 19*s*. 9*d*. $=\frac{2}{5}$ of £1. 2*s*.?

3. (*a*) By selling an acre of land for 60 guineas, I gained $\frac{7}{13}$ of what it cost me; what did it cost me?

(*b*) I sold a horse to *A* for $\frac{1}{6}$th more than it cost me; *A* sold it again to *B* for £18. 13*s*. 4*d*. which was $\frac{1}{6}$th less than it cost him. What did the horse cost me?

(*c*) Divide £2. 13*s*. 8*d*. among 7 men, 5 women and 17 boys, giving each woman $\frac{2}{3}$ of each man's share and each boy $\frac{2}{3}$ of each woman's share.

4. (*a*) What number divided by $\frac{1}{3}$, the quotient by $\frac{2}{5}$, and the next quotient by $\frac{1}{8}$, will give 669?

(*b*) The factors of a certain number are $\frac{7}{12}$, $2\frac{5}{8}$, $\frac{11}{14}$, and $5\frac{1}{4}$; what is $3\frac{5}{9}$ of $\frac{8}{21}$ of $\frac{3}{5}$ of the number?

(*c*) Simplify:

(1) $6+\cfrac{1}{2+\cfrac{1}{3+\frac{1}{4}}}$ (2) $\dfrac{7\frac{5}{9}\text{ of }\frac{8}{17}-1\frac{1}{2}\div 1\frac{1}{4}}{11+\cfrac{1}{7+\frac{1}{2}}}$

5. (*a*) A man earns $16\frac{2}{3}$*s*. a week; what ought he to earn in $5\frac{2}{3}$ mo.?

(*b*) $\frac{4}{5}$ of a draper's stock was destroyed by fire, $\frac{7}{8}$ of the remainder was injured by water; he sold the uninjured goods at cost price, and the injured goods at $\frac{1}{2}$ cost price, and realized £225. What did he lose by the fire?

(*c*) *A* says to *B*; $\frac{1}{3}$ of my money $=\frac{2}{5}$ of yours, and my money is £3. 10*s*. more than yours. How much had *A*?

PAPERS (XL—LI) GENERAL PAPERS UP TO THE END OF VULGAR FRACTIONS.

XL.

1. (*a*) Define number. Write in words 70000530002.

(*b*) The remainder being $=4$ times the quotient $=824$, and remainder + quotient being $=$ divisor, find the dividend.

2. How many more gallons are there in 1 hhd. of wine than in 1 hhd. of beer?

(*a*) (1) A gentleman racked off $1\frac{1}{2}$ butts of beer into the same number of pint and quart bottles; how many dozen of each had he?

(2) The cost of the beer being £20. 5*s*., find the cost of a quart bottle.

(*b*) A bookseller bought 7 reams of paper for £3. 12*s*. 11*d*., the carriage came to 4*s*. 7*d*.; what will he gain, if he sell the outside quires of each ream at $5\frac{1}{2}$*d*. a quire, and the others at $8\frac{1}{4}$*d*. a quire?

3. (*a*) A market-woman bought 165 eggs at 2 for $1\frac{1}{2}$*d.*, and 200 eggs at 3 for $2\frac{1}{4}$*d.*; she sold the whole lot at 5 for $3\frac{1}{2}$*d.*; did she gain or lose by her bargain? how much?

(*b*) A party of gentlemen dined at Greenwich; the bill amounted to £21. 9*s.* 9*d.*; one gentleman paid for himself and three friends £4. 15*s.* 6*d.* Of how many did the party consist?

4. What is meant (1) by a measure of any given number? (2) by a common measure of two or more numbers? (3) by the greatest common measure of two or more numbers?

State the Rule for finding the greatest common measure of two or more numbers.

(*a*) Find the G. C. M. (1) of 144 and 240, (2) of 630 and 1134, (3) of 468 and 1184, (4) of 18, 24, 30, 36 and 42.

(*b*) Find the L. C. M. of (1) 4, 9, 10 and 15, (2) 10, 12, 25 and 32.

5. Define a fraction. How many kinds of vulgar fractions are there? Write down an example of each kind. Write down seven-thirteenths of a yard, and fifteen-twentieths of an ounce.

(*a*) Reduce $10\frac{7}{9}$ to an improper fraction, and $\frac{73}{16}$ to a mixed number, giving the reason for each step.

(*b*) How many apples must I cut up to give to each of 19 children $\frac{1}{3}$ of an apple?

(*c*) Simplify

(1) $\frac{3}{4}+\frac{7}{8}+\frac{1}{5}+\frac{9}{10}$; (2) $19\frac{1}{7}+6\frac{2}{3}+4\frac{4}{5}$; (3) $7\frac{1}{7}-4\frac{1}{8}$.

Why, in adding or subtracting fractions, must you reduce them to equivalent fractions having a common denominator?

XLI.

1. (*a*) *A* leaves *B* $\frac{1}{4}$ of each of the following amounts; twice £407. 8*s.* $6\frac{1}{2}$*d.*, three times £622. 19*s.* $3\frac{1}{4}$*d.*, and five times £190. 3*s.* $2\frac{1}{4}$*d.*; how much less than £1000 does *B* receive?

Explain clearly, by means of this example, the principles of compound multiplication and subtraction.

(*b*) There is a school of 60 children kept open 40 weeks in the year, and 5 days in the week, but the rule is, that the children pay nothing for the days which they attend, but forfeit a halfpenny for every day that they are absent. At the end of the year the payments for absence amounted to £5; what was the average number of children in daily attendance?

2. (*a*) (1) How many more square inches are there in 9 sq. ft., than linear inches in 18 lin^r. ft.?

(*b*) How many more minutes were there between March 31, 1863, and Nov. 1, 1863, than between Nov. 1, 1863, and March 1, 1864, the days named not being counted?

(*c*) A certain quantity of provisions serve 1500 men for 12 wks. at the rate of $1\frac{1}{4}$ lb. a day for each man; how long ought the same provisions to maintain 2250 men at the rate of $\frac{1}{2}$ lb. a day for each man?

3. What is meant (1) by a multiple of any given number? (2) by a common multiple of two or more numbers? (3) by the least common multiple of two or more numbers?

(*a*) Find the L. C. M. of (1) 14, 35, 490 and 98; (2) 15, 42 and 70; (3) 12, 15, 18, 35 and 42.

(*b*) *A* having 210 lambs and 154 pigs, wishes to divide separately into equal lots, each lot containing the largest number possible. Find the number in each lot.

4. Shew from the definition of a fraction that $\frac{4}{6} = \frac{8}{12} = \frac{2}{3}$. How many ninths of an apple are there in 3 apples?

(*a*) Reduce to their lowest terms, (1) $\frac{240}{875}$; (2) $\frac{425}{646}$; and to simple fractions, (3) $\frac{1}{2}$ of $\frac{6}{7}$ of $\frac{14}{33}$; (4) $7\frac{1}{2}$ of $5\frac{1}{6}$ of 11.

(*b*) A man having $\frac{4}{5}$ of £100, gave away $\frac{2}{5}$ of his money; how much did he give away? how much had he left?

(*c*) Simplify:

(1) $\frac{6}{12} + \frac{3}{5} + \frac{4}{8} + \frac{6}{30}$; (2) $17\frac{2}{3} + \frac{4}{5}$ of $7\frac{5}{6}$;

(3) $17\frac{2}{3}$ of $\frac{4}{5} + 7\frac{5}{6}$; (4) $17\frac{2}{3} + \frac{4}{5} + 7\frac{5}{6}$;

(5) $17\frac{2}{3} - \frac{4}{5} - 7\frac{5}{6}$. (6) $17\frac{2}{3} - \frac{4}{5} + 7\frac{5}{6}$.

5. (*a*) *A* is 40 yrs. old, and *B* is 16 yrs. old; how many years ago was *A* 9 times as old as *B*?

(*b*) A groom was hired for 12 mo. for 20 guineas, and some clothes; he left at the end of 8 mo. and received his clothes and £12. 1*s*. 4*d*. What were the clothes valued at?

XLII.

1. Shew that any number is divisible by 9, if the sum of its digits be divisible by 9.

(*a*) A farmer hires a field of 12 ac. 3 ro. 7 po., for which he pays the yearly rent of £41. 11*s*. 7*d*., and another field of 5 ac. 17 po., for which he pays the yearly rent of £15. 2*s*. 1*d*. Find the average rent per acre of the two fields.

(*b*) If a gentleman spend daily during the year 1866 2 guineas, and moreover give away ¼ of this amount in charity, what will he save out of an income of £1500?

2. (*a*) Make a bill of the following articles: 57 yds. of calico at 13¾*d*. a yd., 156½ yds. of flannel at 2*s*. 1½*d*. a yd., 27¾ yds. of broad-cloth at 27*s*. 6*d*. a yd., 39 yds. of drugget at 3*s*. 5*d*. a yd., 11 mats at 9*s*. 11½*d*. each, 75½ yds. of Brussels carpet at 4*s*. 8½*d*. a yd.

(*b*) Two trains start at 8 hr. 5 min. A.M. from stations *A* and *B*, 450 miles apart, and approach each other, the former at the rate of 30 mi. an hour, the latter of 42 mi. an hour; when will they meet, and at what distance from *B*?

3. (*a*) Find the G.C.M. of 576 and 945, and the L.C.M. of 46, 72, 136, 256 and 864.

(*b*) A bag contains a certain number of florins, 3 times as many half-crowns, and as many fourpenny pieces as equal the number of the other coins; their value amounts to £15. 14*s*. 2*d*. How many of each coin does it contain?

(*c*) What is the smallest sum of money with which I can purchase an exact number of pigs at £1. 10*s*. each, or of lambs at £2. 15*s*. each, or of calves at 5 guineas each?

4. What are the two parts of a fraction called? Why?

(*a*) (1) What does $\frac{441}{462}$ mean? Find its simplest form?

(2) Change $\frac{4}{9}$ into an equal fraction having 126 for its den^{r}.

(*b*) Reduce $\frac{3}{4}$, $\frac{1}{8}$, $\frac{2}{7}$, $2\frac{5}{8}$ and $\frac{5}{14}$ to equivalent fractions having the least common denʳ.

(*c*) By how much does the sum of $\frac{51}{75}$, $\frac{131}{150}$, $\frac{24}{25}$, $\frac{1}{2}$ and $\frac{2}{3}$ fall short of 4?

5. (*a*) What number, diminished by the difference between $\frac{3}{4}$ of itself and $\frac{3}{5}$ of itself, leaves a remainder $=34$?

(*b*) What is the product of $12\frac{1}{2}$ multiplied by $5\frac{1}{3}$ times 15?

(*c*) A man owning $\frac{7}{11}$ of a farm, sold $\frac{1}{3}$ of his share; what part of the farm did he still own?

XLIII.

1. (*a*) Multiply two hundred and seven millions nine thousand six hundred and four by 172814412, using only three lines of multiplication.

(*b*) A person left a sum of money to be equally divided among 53 poor people, subject to a tax of 4*d*. in the £, which caused a total deduction of £3. 19*s*. 6*d*.; what did each person receive?

(*c*) Two bales of goods, weighing respectively 1 ton 1 qr. 7 lbs., and 13 cwt. 3 qrs. 23 lbs., come from London to Seaton by L. and N. W. railway; the carriage of the latter was 14*s*. 10*d*. less than that of the former; find the cost of carriage per cwt.

2. (*a*) Find, by practice, the value of 56 cwt. 26 lbs. at £4. 15*s*. 8*d*. a cwt.

(*b*) If 24 men reap 76 ac. in 6 days, how many days ought it to take them to reap 114 ac.?

3. Explain the process of dividing one number by another by long division.

(*a*) Find the quotient of 1871100 by 28350, by splitting each number up into its prime factors.

(*b*) Find the L.C.M. of 270, 189, 297 and 243, and the G.C.M. of 98746 and 443193.

4. How many acres are there in 1 square mile?

(*a*) How many links must be added to the number of links in 4 mi. 51 chs. 73 lks. to make the sum total equal to the number of sq. yds. in 22 ac. 3 ro. 33 po. $2\frac{3}{4}$ yds.?

(*b*) A spirit merchant bought 15 gallons of whiskey at 14*s.* 6*d.* a gal^{n}.; he reserved 4 gal^{s}. for his own use, and after mixing the remainder with water, sells the mixture at 12*s.* a gal^{n}., and gains on his outlay 34*s.* 6*d.* How much water did he add?

5. Define a mixed number. What is the difference between $3\frac{1}{4}$ and $3 \times \frac{1}{4}$?

(*a*) Reduce to their simplest forms:

(1) $\frac{42}{110}$ of $\frac{8}{19}$ of $\frac{330}{11}$ of $3\frac{3}{18}$; (2) $\frac{1}{2}$ of $\frac{2}{5} + \frac{4}{7}$ of $9 + 14\frac{9}{10}$;

(3) $90\frac{1}{10} + 43\frac{4}{5} + 65\frac{19}{25}$; (4) $43\frac{5}{12} - 27\frac{5}{8}$;

(5) $\frac{15}{33} \div 20$; (6) $210 \div \frac{15}{16}$.

(*b*) How many times can a cup holding $\frac{11}{12}$ of a gallon be filled from a butt of beer? How much will be left in the cask after the last full cup has been drawn?

(*c*) Out of a cistern, which is $\frac{2}{3}$rds full, 20 gallons are drawn; the cistern is then found to be $\frac{3}{5}$ths full. How much will the cistern hold?

XLIV.

1. Explain the term 'vinculum or bracket.'

(*a*) Find the value of

(1) $2025 \div 45 - 640 \div 20 + 57024 \div 81$;

(2) $(408 + 630) \times (890 - 784)$;

(3) $(30321 - 208 + 9079) \div (236 - 107 + 423)$.

(*b*) A chemist fills 8 bottles of equal size with 7 lbs. 2 oz. 7 drs. 12 grs. of laudanum; find the weight of laudanum in each bottle. Explain the process.

2. (*a*) If a steamer take $5\frac{1}{3}$ hrs. to go from Newhaven to Dieppe, 80 miles, how long ought it to take to go from Southampton to Havre, 120 miles?

(*b*) A cook, who is hired for 20 guineas a year, comes to her place on the 5th of June and leaves on the 29th of October; what wages ought she to receive?

3. (*a*) A farmer having a triangular piece of land, the sides of which are 264 ft., 583 ft. and 715 ft., wishes to enclose it with a panelled fence, each panel being of greatest possible uniform length; find the number of panels required.

(*b*) At a collection after a sermon on the Humiliation day for the Cattle Plague, the plates were found to contain 1 five pound note, 4 sovereigns, 7 half-sovereigns, 25 half-crowns, 37 florins, 174 shillings, 87 sixpences, 103 three-penny pieces, and 235 halfpence; after giving each of the 20 oldest men and 20 oldest women 4*s.* 6*d.*, it was found that there was enough, and $6\frac{1}{2}$*d.* over, to give each family in the parish 8*s.* 6*d.* How many families were there?

4. When is a fraction said to be in its lowest terms? How are fractions compared?

(*a*) Simplify;

(1) $\frac{6042}{8162}$; (2) $\frac{1}{2}+\frac{2}{9}+\frac{3}{11}+\frac{7}{18}+\frac{17}{33}$;

(3) $\frac{1}{2}+\frac{2}{9}-\frac{3}{11}+\frac{7}{18}-\frac{17}{33}$; (4) $\frac{1}{2}+\frac{2}{9}-\left(\frac{3}{11}+\frac{7}{18}\right)+\frac{17}{33}$;

(5) $2\frac{2}{5}$ of $2\frac{4}{7}$ of $\frac{2}{11}\times 1\frac{7}{15}$ of $26\frac{1}{4}\div 21\frac{3}{5}$.

(*b*) What number must you subtract from $560\frac{5}{8}$ to leave a remainder = the sum of $126\frac{1}{7}$ and $240\frac{3}{4}$?

5. (*a*) If 30 horses eat $25\frac{5}{7}$ bus. of oats in 6 days, how much will one horse eat in a week?

(*b*) Of what number is $2\frac{1}{8}$ the $\frac{5}{6}$th part?

(*c*) A man, after spending $\frac{1}{2}$ of his money, and then $\frac{1}{3}$ of the remainder, and then $\frac{1}{4}$ of what then remained, had £25 left; how much had he at first?

XLV.

1. How many linear inches in 1 linear pole? How many square inches in 1 square pole?

(*a*) I was able to divide a certain field, after deducting

1 ro. 3 po. 9½ sq. yds. for paths, into 27 cottage allotments, each containing 1 ro. 6 po. 7½ sq. yds.; find the size of the field.

If each allotment yield 5 bus. of barley at 3*s.* 9½*d.* a bus., and 18 bus. of potatoes at 2*s.* 11½*d.* a bus., find the value of the produce of the field.

(*b*) The fore-wheel of a carriage makes 8400 revolutions in a journey; the fore-wheel is 6 ft. 8 in. round, and it is 5 ft. less round than the hind-wheel. How many revolutions does the hind-wheel make?

2. (*a*) Find the cost of 37 silver ornaments, each containing on the average 3 lbs. 15 dwts. 6 grs. of silver, at 10*s.* an oz.

(*b*) A rate of 7½*d.* in the £ on the rateable value of a parish amounts to £333. 9*s.* 8½*d.*; the rateable value is obtained from the gross value by deducting one-third of the gross value; find the gross value of the parish.

3. Shew that the L. C. M. of two numbers equals their product divided by their G. C. M.

A national school master divided his scholars, consisting of 221 boys and 143 girls into the largest possible equal classes, so that each class of boys should number the same as each class of girls. Find the number of classes.

4. State the rule for the multiplication of fractions, and give the reason for it.

(*a*) (1) Which is the greatest, and which the least of $\frac{7}{15}, \frac{9}{17}, \frac{13}{25}, \frac{23}{24}$? (2) By how much does the sum of the greatest and least exceed the sum of the other two?

(*b*) A number increased by its fourth part equals 35. Find the number.

5. (*a*) Simplify:

(1) $(2346784 \times 53 \div 583) + (107298 \div 18 \times 79)$;

(2) $\left(\frac{6}{7} - \frac{2}{3}\right) \div \left(\frac{3}{4} + \frac{2}{3}\right)$; (3) $\frac{6}{7} - \frac{2}{3} \div \frac{3}{4} + \frac{2}{3}$;

(4) $$\left(\frac{\frac{2}{3} \text{ of } \frac{3}{4}}{\frac{1}{2}} + \frac{\frac{2}{5} \text{ of } \frac{5}{6}}{\frac{2}{9} \text{ of } 4\frac{1}{2}}\right) \div \left(\frac{\frac{2}{3} \text{ of } \frac{3}{4}}{\frac{1}{2}} - \frac{\frac{2}{5} \text{ of } \frac{5}{6}}{\frac{2}{9} \text{ of } 4\frac{1}{2}}\right).$$

(*b*) (1) Divide £120. 7*s.* 10¼*d.* by $8\frac{7}{9}$, and multiply the result by $4\frac{8}{9}$.

(2) Find the value of $\frac{129}{200}$ of a day, and of $\frac{3}{7}$ of 2 miles.

XLVI.

1. (*a*) The value of unity being $1\frac{1}{3}$ in., and the eights in the number 580008653 denoting the respective distances of *A* and *B* from *C* a given spot on the road between them, find the distance between *A* and *B*.

(*b*) If a farmer can keep 17 cows, that each makes £15 worth of butter and milk &c. a year, on 35 ac. 1 ro. 23 po.; for which he pays a yearly rent of £2. 10*s*. an ac., what is his yearly gain from the cows, supposing him to put aside 47 guineas a year for losses, &c.?

2. (*a*) How much will it cost to clothe ten thousand soldiers, if a coat take $1\frac{3}{4}$ yd., a pair of trousers $1\frac{1}{3}$ yd., and a waistcoat $\frac{3}{4}$ yd., the price of the material being 16*s*. $9\frac{3}{4}$*d*. a yd., and the cost of making each suit 9*s*. 4*d*.?

(*b*) The guardians of a union lay in a stock of cheese sufficient to supply 75 inmates, at a given allowance to each per day, for 32 days; a certain number of the inmates leave at the end of 2 days; it is then found that the unconsumed cheese will last those who remain for 45 days. How many leave?

3. (*a*) A bankrupt owes 4 creditors £1500; his property is worth £468. 15*s*.; the claims of two of the creditors are £263. 1*s*. 8*d*., and £403. 12*s*. 4*d*. respectively, to one of the other two he owes half as much again as he owes to the other. What dividend will each of the latter receive?

(*b*) If $1\frac{1}{3}$ yd. of butter weigh $1\frac{1}{4}$ lb., how many inches of butter can be bought for $2\frac{1}{3}$*d*., when butter is 1*s*. 6*d*. a lb.?

4. State the rule for subtraction of fractions, and give the reason for it.

Simplify:

(1) $\frac{1389}{3704}$; (2) $\frac{5}{7}+\frac{8}{13}+\frac{17}{42}+\frac{9}{52}+\frac{15}{78}$;

(3) $\frac{5}{7}-\left(\frac{8}{13}-\frac{17}{42}+\frac{9}{52}\right)-\frac{15}{78}$; (4) $\dfrac{2\frac{2}{3}\text{ of }\frac{5}{7}}{6\frac{2}{7}\text{ of }\frac{8}{11}}\div\frac{1\frac{1}{3}}{9}$.

5. (*a*) The product of three numbers is 340; the first is $7\frac{3}{5}$, the second is less than the first by $1\frac{7}{20}$. Find the third number.

(*b*) A regiment, returning from foreign service, has only $\frac{11}{27}$ of its original number of men; it has lost $\frac{2}{9}$ of its original number in battle, $\frac{1}{3}$ by sickness, and 36 have deserted. What was the original number?

XLVII.

1. (*a*) Explain how you find the total rem^{r}., when you divide by the factors of a composite number. Ex. 503001 ÷ 660, or ÷ by its factors, 3, 11, 5 and 4.

(*b*) Find the values of

(1) $7095-701+579-(650-469)-1005$,

(2) $7095-\{701+579-(650-469)-1005\}$,

(3) $\{450+(24-15)\times 9\}\div\{406-397\}$.

2. (*a*) An alteration in the income tax diminishes a tax, which is £37. 17*s*. 7⅓*d*. when the tax is 9½*d*. in the £, by £14. 19*s*. 0¾*d*. What is the diminished rate of the tax in the £?

(*b*) 2 ducks are worth 3 chickens, and 2 geese are worth 7 ducks; find the value of a goose, a pair of chickens being worth 5*s*.

3. (*a*) My watch, which marked the correct time at 10.30 A.M. on Thursday July 19, 1866, gained uniformly, and on the following Tuesday at 6.30 P.M. marked 6.42; find the rate of the watch's gain per day.

(*b*) 3 dozen spoons, each spoon weighing 3 oz. 7 dwts. 20 grs., and 2 salvers, one of them half as heavy again as the other, are made out of 24 lbs. 2 oz. 17 dwts. of silver. Find the value of the lighter salver, reckoning 10*s*. 5*d*. as the worth of 1 oz. of silver.

4. How does a simple fraction differ from a complex one?

(*a*) (1) A boy has ⅔rds of an orange; to how many children can he give ⅙th of the orange? What part of the orange will he have left?

(2) Which would you rather have, ⅔rds or ¾ths of a cake? Why?

(*b*) Compare the values of $\frac{2}{25}$, $\frac{3}{10}$, $\frac{7}{50}$ and $\frac{8}{65}$. Take the sum of the 1st and 3rd from the sum of the 2nd and 4th.

5. (*a*) Simplify.

(1) $\frac{2}{3}$ of $6\frac{7}{16}-\frac{5}{9}$ of $4\frac{8}{15}$; (2) $\frac{2}{3}$ of $\left(6\frac{7}{16}-\frac{5}{9}\right)$ of $4\frac{8}{15}$;

(3) $\frac{2}{3}$ of $\left(6\frac{7}{16}-\frac{5}{9}\text{ of }4\frac{8}{15}\right)$; (4) $\left(1+\cfrac{1+\frac{1}{5}}{5}\right)\div\left(1+\cfrac{5}{1+\frac{1}{5}}\right)$.

(*b*) What fraction must be added to the sum of $\frac{14}{45}$, $\frac{27}{39}$ and $\frac{2}{21}$ to make the result a whole number?

(*c*) A lady having spent $\frac{1}{5}$ of her money in one shop, and $\frac{1}{4}$ of it in another, had £3. 17*s*. left; what money did she start with?

XLVIII.

1. (*a*) Shew that 5 × 6 = 6 × 5. Find the sum of the 12 numbers that follow $\overline{\text{XC}}\text{DCCCLXXX}$.

(*b*) What is the amount of a bill for $\frac{3}{4}$ cwt. of sugar at $4\frac{1}{2}$*d*. a lb., $1\frac{1}{2}$ cwt. of rice at $4\frac{3}{4}$*d*. a lb., 70 lbs. of currants at £2. 6*s*. 8*d*. a cwt., and 25 lbs. of tea, $1\frac{1}{2}$ cwt. of it costing £28. 10*s*. 6*d*.?

2. (*a*) A train, which travels at the uniform rate of 66 ft. a second, leaves London at 8.35 A.M.; when will it reach Edinburgh, the distance from London to Edinburgh being 405 mi.? At what distance from Edinburgh will it meet a train which leaves Edinburgh for London at 11 o'clock, and travels one-third faster than it does?

(*b*) The larger of two cheeses weighed 3 lbs. 2 oz. more than the other, which weighed 13 lbs. 10 oz.; a third cheese exceeded in weight half the sum of the weights of the others by 11 oz. Find by practice the cost of the 3 cheeses at 1*s*. a lb.

3. (*a*) Simplify (1) $(2\frac{1}{2}+3\frac{1}{3}+4\frac{1}{4})\times1\frac{1}{3}$ of $1\frac{10}{11}$,

(2) $\dfrac{\frac{2}{5}\text{ of }\frac{5\frac{1}{3}}{4\frac{1}{2}}}{2\frac{2}{3}\text{ of }8\frac{1}{3}\text{ of }3\frac{1}{5}}\div\dfrac{6\frac{1}{3}-5\frac{4}{15}}{\frac{5}{9}\text{ of }\frac{3}{7}}$, (3) $\frac{901}{713}\div\frac{1343}{1219}\times\frac{2449}{5353}$.

(*b*) (1) Reduce $\frac{5}{9}$ of 16*s*. $0\frac{1}{2}$*d*. to the fraction of $1\frac{1}{2}$ guinea.

(2) Find the value of $6\frac{7}{10}$ day $-\frac{9}{14}$ week $-\frac{11}{15}$ min. $+\frac{3}{5}$ hr.

4. (*a*) If $\frac{3}{5}$ of a bus. of wheat be worth $\frac{3}{4}$ of a bus. of barley, and 1 bus. of barley be worth $\frac{2}{3}$ of a crown, how many qrs. of wheat can be bought for £15?

(*b*) Divide £100 between two persons, giving one $\frac{7}{9}$ as much as the other.

5. (*a*) A boy, in flying his kite, lost $\frac{3}{5}$ of the string, he then added 65 ft., and he then found that it was just $\frac{5}{6}$ of the original length. What was the length at first?

(*b*) A man working 12 hrs. a day can complete a certain piece of work in 7 days; how many hours a day must he work to complete a piece of work 3 times as large in 28 days?

XLIX.

1. (*a*) Divide 26 ac. 17 po. $14\frac{1}{2}$ sq. yds. among *A*, *B* and *C*, giving *B* half as much again as *A*, and *C* half as much again as *A* and *B*.

(*b*) Two women each buy a pound's worth of herrings at 11 for 1*s*.; the 1st sells them at $1\frac{1}{2}$*d*. each, the 2nd at 1*s*. $4\frac{1}{2}$*d*. a dozen. Which gains most?

State the Rule for Division of Fractions. Give the reason for it, taking $\frac{9}{16}\div\frac{5}{14}$ as an Ex.

2. (*a*) Simplify (1) $\frac{21120}{71040}$; (2) $3\frac{5}{8}$ of $\frac{5}{7}$ of $\frac{32}{301}$ of 49 of $1\frac{14}{25}$;

(3) $4\frac{3}{8}-\frac{9}{11}$ of $\frac{1}{6}$ of $15\frac{1}{2}+\frac{1}{5}$ of $9\frac{3}{8}+5-\frac{4}{7}$ of $6\frac{1}{2}$;

(4) $4\frac{3}{8}-\frac{9}{11}$ of $\left(\frac{1}{6}\text{ of }15\frac{1}{2}+\frac{1}{5}\right)$ of $9\frac{3}{8}+\left(5-\frac{4}{7}\right)$ of $6\frac{1}{2}$;

(5) $\dfrac{\frac{5}{9} \text{ of } 7\frac{3}{11}}{\frac{4}{11} \text{ of } 11\frac{3}{7}} + \dfrac{40}{\frac{4}{7}} - \dfrac{8\frac{4}{7}}{20} \div \dfrac{11\frac{3}{32}}{8\frac{1}{8}}$.

(*b*) If the smaller of two fractions be $\frac{4}{11}$, and their difference $\frac{2}{5}$, what is their sum? Find the quotient of the sum divided by twice the difference.

3. (*a*) How many bus. of wheat, at $\frac{2}{7}$ of £1¾ a bus., will pay for 15 qrs. of oats, at $\frac{5}{6}$ of 2 guineas a qr.?

(*b*) A person agrees to complete a piece of work in 30 days; what part of it ought he to do in 16½ days? How much less than $\frac{3}{4}$ of the work will be done?

4. (*a*) *A* owned $\frac{5}{6}$ of a mine, and sold $\frac{3}{4}$ of his share to *B*, who sold $\frac{1}{2}$ of his share to *C*, who sold $\frac{2}{3}$ of his share to *D*; *D*'s share was worth £2056. 10*s*.; what was the worth of *B*'s remaining share, and what the worth of the whole mine?

(*b*) The product of two numbers is 17; one of them is 3 times $\dfrac{1+3\frac{5}{8}}{3\frac{1}{12}}$; find the other.

5. (*a*) $\frac{1}{3}$ of a package of cloth is sold at 2*s*. 6*d*. a yd.; $\frac{1}{4}$ of it at 1*s*. 6*d*. a yd.; the remaining 25 yds. at 1*s*. 10*d*. a yd., gaining 2*d*. a yd. on the cost price. Find the whole gain.

(*b*) The gross rental of a parish being £2729, its rateable value is taken at $\frac{3}{4}$ths of this sum. A rate of £85. 5*s*. 7½*d*. is levied. (1) What is the rate in the £? (2) What fractional part of the whole property in the parish belongs to a man whose rate amounts to £39. 15*s*. 11½*d*.?

L.

1. (*a*) How may any number be multiplied by 728 in two lines?

Ex. Nine millions thirty thousand and seven multiplied by 728.

(*b*) A grocer bought 48lbs. of coffee at 10*d.* a lb., and mixed it with 12lbs. of chicory. By selling the mixture at 13½*d.* a lb. he gained £1. 4*s.* 9*d.* What did the chicory cost per lb.?

2. Shew that any number is divisible by 25, if the number expressed by its two right-hand figures be divisible by 25.

(*a*) A gentleman bought a common for £19488, and after expending £2045 in improvements, sold half of it for £21344 at £23 an acre. How many acres did the common contain, and what was the cost price of it per acre? Explain each step of the operation.

(*b*) If 16 × 10 × 14 × 40 × 65 × 18 × 84 × 45 be divided by 50 × 24 × 70 × 26 × 7 × 12, find the quotient.

3. (*a*) If 6 apples and 7 apricots cost 2*s.* 10¼*d.*, and 10 apples and 8 apricots cost 3*s.* 5½*d.*, what is the cost of one of each?

(*b*) If 36 plots of ground, each containing 4 sq. po. 9 sq. yds. 94 sq. in., be taken out of a field of 2½ac., how much remains?

If as many more plots of the above size as is possible be taken from the remainder, what space will then remain?

4. (*a*) Simplify (1) $\frac{6}{13}+10\frac{2}{9}$ of $1\frac{1}{26}+4\frac{12}{78}$ of $3\frac{1}{3}-4$.

(2) $\frac{6}{13}+10\frac{2}{9}$ of $(1\frac{1}{26}+4\frac{12}{78})$ of $3\frac{1}{3}-4$.

(3) $$\frac{5\frac{5}{8}+5\frac{1}{6}}{5\frac{5}{8}-5\frac{1}{6}} \div \frac{(4\frac{2}{3}-4\frac{7}{12}) \text{ of } \frac{24}{33}}{4\frac{2}{3}+4\frac{7}{12} \text{ of } \frac{24}{33}}.$$

(*b*) In a cricket match the first two players who went in on one side each made $\frac{1}{9}$th of the whole score; the next two did not score; the next three made between them $\frac{5}{12}$ths of the whole score; the next three made as many as the first two; the last man scored 36, and there were 14 wides, &c. What was the whole score?

5. (*a*) A soft water cistern, $\frac{3}{4}$ full, sprung a leak at the

commencement of a shower; during the shower $\frac{5}{8}$ of the water in it at the commencement ran out; but rain came in, which would have filled $\frac{1}{3}$ of the cistern. How far was the cistern from being full at the end of the shower?

(*b*) There are two fractions whose sum is $\frac{113}{126}$, and whose difference is $\frac{7}{18}$; find the fractions, and the quotient of the greater by the less.

LI.

1. (*a*) Twenty burners, each consuming $4\frac{1}{2}$ cub. in. of gas per second, are alight for 6 hours daily during the month of November; find the cost of the gas at 4*s*. 6*d*. per thousand cubic feet.

(*b*) A bankrupt owes £1920; he has debts due to him to the amount of £2362. 10*s*.; but on one-third of these debts he can recover 16*s*. in the pound, and on the rest only 5*s*. 11*d*. in the pound; moreover he has other property, which, after paying the expenses of the bankruptcy, amounts to £104. 1*s*. 3*d*. What dividend can he pay?

2. (*a*) Find by practice the value (1) of 16 dozen pairs of boots at 19*s*. $7\frac{1}{2}$*d*. a pair, and (2) of $305\frac{2}{5}$ cwt. of sugar at $3\frac{1}{2}$ guin^{s}. a cwt.

(*b*) Explain the reason of the Rule for casting out the nines in Multiplication, by taking as an Ex. 803 × 75.

3. (*a*) If a horse eat $\frac{3}{8}$ bus. of oats a day, what will it cost to feed 18 horses with oats for 6 weeks, when oats are 32*s*. 8*d*. a qr.?

(*b*) If a Bible cost $\frac{5}{8}$ of a guinea, and a Prayer-Book $\frac{2}{3}$ of a Bible, find the cost of a Prayer-Book?

(*c*) If a turkey cost £$\frac{5}{7}$, and a goose £$\frac{3}{10}$, how many turkeys and geese, an equal number of each, can be bought for £14. 4*s*.?

4. What is a compound fraction? How is it reduced to a simple fraction?

(*a*) (1) Express $\frac{15}{31}$ as a fraction with denominator 186. (2) Multiply 13 cwt. 15 lbs. $7\frac{5}{8}$ oz. by $23\frac{3}{5}$, and prove the truth of the result.

(*b*) (1) Write down in order of magnitude $\frac{9+10}{10+11}$, $\frac{9}{10}$, and $\frac{10}{11}$. (2) Find the difference between the sum of the first two of the above fractions, and the sum of the last two.

(*c*) (1) What part of $1\frac{1}{2}$ mi. is $\frac{9}{10}$ ft.? (2) What part of a hhd. of beer is $\frac{5}{9}$ of a quart?

5. (*a*) 35 women can do as much work as 20 boys, and 16 boys as much as 7 men; how many women can do the work of 13 men?

(*b*) Three carpenters can finish a certain job in 2 mo., two of them can do it in $2\frac{1}{2}$ mo.; how long will it take the 3rd man to do it?

PAPERS (LII—LVIII) ON DECIMALS.

LII.

1. Define a Decimal. How do decimals differ from common fractions?

(*a*) Write as decimals: seven tenths; sixty-six hundredths; three hundredths; sixty-one hundred-thousandths; sixteen, and five thousandths; nine hundred and fifty, and nine hundred and nine millionths.

(*b*) Write the foll^{g}. fractions, and mixed numbers, decimally;

$\frac{104}{1000}$; $\frac{73}{10000}$; $\frac{601}{1000000}$; $6\frac{4}{100}$; $75\frac{37}{1000000}$; $500\frac{200002002}{1000000000}$.

2. What is the place on the right of the decimal point and next to it called, and what is its unit? What is the fourth place on the right called, and what is its unit?

(*a*) Shew that ·6 = ·60 = ·6000.

(*b*) Multiply ·6 by 10, by 1000, by 1000000.

(*c*) Divide ·6 by 10, by 1000, by 1000000.

3. State the Rule for Addition of Decimals.

Work the foll^s. Ex^s., and prove the truth of each result by fractions:

(1) 37·04 + 704·3 + 2·0376 + 500.

(2) 100·375 + ·24 + 99 + ·00574 + 2·536.

(3) 32·95 − 7·9809. (4) 5·0001 − ·1111.

(5) 40·6 × ·12. (6) 40·6 × ·0012. (7) 40·6 × 1200.

4. (*a*) Find the sum of one hundred dollars five cents four mills; nine dollars three mills; twenty-seven dimes fifteen mills; fifty dollars fifty mills. Note, 1 dollar = 10 dimes = 100 cents = 1000 mills.

(*b*) A lady spent 18 fr. 5 c. at one shop, 37 fr. 67 c. at another, 35 c. at a third, and 40 fr. at a fourth; what will she have left out of 100 fr.? Note, 1 fr. = 100 c.

5. (*a*) From three hundred and sixty-five and seventy-five ten-thousandths take eighty-nine and three millionths.

(*b*) A man bought 6 chests of oranges, each containing 600 oranges, at 1 fr. 2 c. a dozen; what did they cost in English money, if 1 fr. = $9\frac{1}{2}d$.?

(*c*) Find the value of 68 lbs. of butter at 1 fr. 26 c. a lb., 70 lbs. of beef at 75 c. a lb., 1 hhd. of beer at 1 fr. 5 c. a gallon, and 18 yds. of calico at 2 fr. 9 c. a yd.

LIII.

1. How are decimal fractions expressed? In ·4 and ·004, how many of the units in the 2nd are contained in one unit of the 1st?

(*a*) Write the foll^s. fractions and mixed numbers, decimally:

$$\frac{16}{100};\ \frac{16}{10};\ \frac{16}{100000};\ 27\tfrac{17}{100000};\ 10\tfrac{5061}{100};\ 3\tfrac{400004}{1000}.$$

(*b*) Express in decimal figures two hundred, and nineteen ten-thousandths; two, and three ten-millionths; six thousand, and eight hundred and forty millionths; seven, and one hundred and twenty tenths.

2. (*a*) Express (1) 15 dolls. 19 c. 7 mills, (2) 4 dolls. 4c., (3) 14 mills, each in terms (1) of dollars, (2) of cents, (3) of mills.

(*b*) Express (1) 54 fr. 2 c., (2) 45 fr., (3) 5 fr. 27 c., (4) 5 c., each in terms (1) of francs, (2) of centimes.

3. State the Rule for Subtraction of Decimals.

(*a*) Work the foll^{g}. Ex^{s}., and prove the truth of each result by fractions.

(1) $8{\cdot}25 + {\cdot}0074 + 6{\cdot}2000550 + 563 + 3{\cdot}1 + {\cdot}00010075$.
(2) ${\cdot}5 + 53{\cdot}30712 + 12{\cdot}060 + 530{\cdot}04700025 + 727{\cdot}31$.
(3) $1000{\cdot}1 - 9{\cdot}01$. (4) $36{\cdot}5043 - 9{\cdot}0097506$.
(5) $2{\cdot}0065 \times {\cdot}005$. (6) $2{\cdot}0065 \times 500$.
(7) $200{\cdot}65 \times {\cdot}005$. (8) $2{\cdot}0125 \div 3{\cdot}5$.
(9) $2{\cdot}0125 \div 35$. (10) $20125 \div {\cdot}00035$.

(*b*) (1) Paid a man for a pair of horses 2015 fr. 50 c., for a carriage 20 fr. 68 c. less than for the horses; for harness $\frac{1}{4}$ of the cost of horses and carriage. Find the entire cost.

(2) From twenty-seven thousands take twenty-seven thousandths.

4. (*a*) What is the difference between (1) 2 dolls. and 1 mill? (2) 75 cents and 2 mills? (3) 17 fr. 1 c. and 9 fr. 87 c.?

(*b*) What number must be added to the sum of three and four hundred-thousandths, twenty-seven and nineteen millionths, fifteen and five tenths to make the result equal to fifty and one thousandth?

(*c*) What is the quotient of $129{\cdot}75896 \div$ (1) by 8, (2) by ·08, (3) by ·0008, (4) by 800, (5) by 8000000.

5. (*a*) Reduce to decimals:

(1) $\frac{11}{16000}$. (2) $15\frac{3476}{15625}$. (3) $3\frac{6\frac{3}{4}}{11\frac{1}{4}}$. (4) $7\frac{{\cdot}25}{{\cdot}00125}$.

(*b*) Divide ·2 by ·06, and 6·35 by ·425, each to 4 places of decimals, and prove the truth of each result by fract^{ns}.

(*c*) (1) Compare the values of ·875 of 10*s*. 6*d*., and ·785 of 13*s*. 4*d*.

(2) Express 9¾*d*. as the dec^{l}. (1) of £1, (2) of £1000.

LIV.

1. Shew that prefixing cyphers to a decimal diminishes its value ten times for every cypher prefixed. Does the annexing cyphers to a decimal alter its value? Why so?

(*a*) Express as vulgar fractions in their lowest terms:

·4; ·036; 2·05; 500·0709; 53·0000100.

(*b*) Write in words:

·15; ·0915; ·00780; 12·043; 7·07951506.

(*c*) Multiply 25·007 (1) by 100, (2) by 100000, (3) by 100000000. (*d*) Divide ·000082 and also 791 (1) by 1000, (2) by 10000000.

2. (*a*) Express (1) $14. 9 c., (2) $71. 4 mills, (3) $6\frac{1}{4}$ cents each in terms (1) of dollars, (2) of dimes, (3) of mills.

(*b*) Write down in terms of dollars, &c. (1) $124·05, (2) $54·506, (3) $6·48$\frac{1}{2}$; also in term of francs and centimes, (1) 6·05 fr., (2) ·0125 fr., (3) $37\frac{1}{2}$ fr.

3. (*a*) A man has 6 children; to the eldest he gives half as much again as to any of the rest of the children, who each receive $1506·004; how much did he give to all of them?

(*b*) A house and furniture are worth 17443 fr. 50 c., the house being equal in value to 4 times the furniture less 56 fr. 75 c.; how much is the furniture worth?

4. (*a*) A farmer bought 48·125 tons of hay; for 20·25 tons of it he gave 80 fr. a ton, for the rest 73 fr. 5 c. a ton; he sold all the hay at the average price of 3 fr. 78 c. a cwt.; did he gain or lose? How much?

(*b*) A butcher bought an equal number of calves and sheep for £265; for the calves he gave £3·75 a head, and for the sheep £2·875 a head; how many did he buy of each kind?

5. (*a*) Convert into decimals (1) $\frac{33}{125}$; (2) $\frac{17}{20}$; (3) $3\frac{872}{1250}$; and (4) $9\frac{7}{800}$.

(*b*) Find the value of (1) ·890625 bus., (2) £2·3375, and explain the method in each case.

(*c*) Reduce (1) 2*s.* 9*d.*, (2) 12*s.* 0$\frac{3}{4}$*d.* to the decimal of £1, and also of £2. 10*s.*, and explain the process in each case.

LV.

1. What does ·03 become (1) by prefixing three cyphers, (2) by affixing three cyphers?

(*a*) Write in words 2·0001; 742·4; 54·2600; ·00104.

(*b*) If £1 = 10 florins = 100 cents = 1000 mills, express each of the foll^{g}., £20, 5 c. 4 m.; £100. 105 m.; 7 c. 6 m.; 15 fl. 15 m.; £4. 3 m. (1) in £'s, (2) in florins, (3) in cents, (4) in mills.

2. (*a*) What number added to the sum of ·0007 + 2·4 + ·05 + 3·0436 + ·047 will make an integer?

(*b*) Find the sum of 39 and 4 tenths, 360 and 49 ten-thousandths, 9 and 9 millionths, 1 hundredth, 13 and 1040 hundred-thousandths.

(*c*) From the sum of 1 tenth and 1 thousandth take their difference, and prove the truth of each step in the operation.

3. State the Rule for the Multiplication of Decimals.

(*a*) Find the cost of 506·4 lbs. of tea at 4 fr. 5 c. a lb.

(*b*) Find the continued product (1) of 2·03 × 203 × ·00203 × 20300, (2) of 16·075 × 570 × ·01001 × 10·01. Prove the truth of each result by fractions.

(*c*) Find the entire cost of $17\frac{1}{2}$ yds. of flannel at 2 fr. 50 c. a yd., 54 yds. of calico at 84 c. a yd., $25\frac{3}{4}$ yds. of muslin at 3 fr. 5 c. a yd., 35 yds. of silk at 7 fr. 25 c. a yd., and 5 doz. pairs of gloves at 2 fr. 20 c. a pair.

4. (*a*) Divide ·585 and also 585 (1) by ·9, (2) by 900, (3) by ·00009.

(*b*) Divide (1) ·8 by 476·3, (2) 36·34 by 674, each to 4 places of decimals, and prove the truth of each result.

(*c*) If 35 yds. of flannel cost 122 fr. 50 c., what will 29 yds. cost?

5. What are circulating decimals? What is the difference between pure and mixed circulating decimals? What fractions are convertible into terminating decimals?

(*a*) Convert into decimals (1) $2\frac{15}{17}$, (2) $19\frac{1}{30480}$, (3) $\frac{4}{5}+6\frac{1}{2}+9\frac{3}{4}$, (4) $2\frac{3}{5}$ of $8\frac{3}{4}-\frac{1}{2}$ of $1\frac{2}{3}$ of $\frac{7}{8}+\frac{11}{12}$ of $7\frac{4}{11}$.

(*b*) Express the difference between $\frac{3}{4}$ pk. and ·0625 of a bus. as the decimal of a quarter.

(*c*) A gentleman having given $\frac{5}{9}$ of the money in his purse for a sheep, and ·375 of the remainder for a pig, had £1·6875 still left; what sum had he at first? What decimal part of his money did he give for the sheep, and what for the pig?

LVI.

1. State the Rule for converting pure circulating decimals into vulgar fractions.

(*a*) Convert into vulgar fractns. $\cdot\dot{4}\dot{8}$; $\cdot\dot{0}0\dot{9}$; $\cdot 0\dot{1}0\dot{1}$; $7\cdot\dot{6}72\dot{6}$.

(*b*) Find the value of $\cdot\dot{4}\dot{5}$ of £1. 13*s*., and of $\cdot\dot{7}1428\dot{5}$ of $2\frac{1}{2}$ ac.

2. (*a*) A man, who owns $\frac{7}{8}$ of a farm, sells $\frac{4}{11}$ of his share; what decimal part of the farm does he still own?

(*b*) Reduce to decimals (1) $\left(\frac{1\frac{3}{4}}{4\frac{1}{2}} \div \frac{2\frac{1}{3}}{2\frac{1}{4}}\right) \times \frac{4}{5}$ of $3\frac{1}{2}$, (2) $\frac{\frac{5}{8} \text{ of } 16\cdot125}{4\frac{7}{8}}$. (3) Add $4\frac{3}{4}$, $\frac{123}{500}$, $4\frac{2}{25}$ and $5\frac{11}{1250}$ by vulgar and also by decimal fractions, and shew that the results agree.

3. (*a*) If a man travel 10 mi. in 1·5 hr., what decimal part of an hr. ought he to take to travel 4 mi.?

(*b*) What number multiplied by $\frac{2}{3} + \frac{5}{8} + \frac{1}{16} - 1\frac{1}{8}$ will produce ·37575?

4. (*a*) Divide £870 between *A*, *B* and *C*, so that ·75 of *C*'s share shall $=\cdot 5$ of *A*'s, or $=\cdot\dot{6}$ of *B*'s.

(*b*) 7 men could do a piece of work in a given time, 3 of the men do not come; the rest take $7\frac{1}{2}$ days more than the given time to complete it. Shew that the 7 men would have done ·1 of the work in a day.

5. (*a*) A corn dealer bought 198 bus. of barley for £32·5875, 100 bus. of which he sold for £·2375 a bus. At what price per qr. may he sell the remainder so as to gain £2·1875 by his bargain?

(*b*) If 40 men can reap 400·6 ac. in 12·75 days, how many ac. ought 30 men to reap in 3·4 days?

LVII.

1. State the Rule for converting mixed circulating decimals into vulgar fractions.

(*a*) Convert into vulgar fractions $\cdot 6\dot{2}$; $\cdot 007\dot{3}$; $2\cdot 3\dot{4}\dot{5}$; $\cdot 52\dot{2}\dot{0}$; $17\cdot 015\dot{9}\dot{0}$.

(*b*) Find the values (1) of $\cdot 4791\dot{6}$ of £1, (2) of $\cdot 14\dot{6}\dot{9}$ of a furlong.

(*c*) Find the value of (1) 2·95 tons – 17·09375 cwt. + $3\cdot\dot{6}071428\dot{5}$ of 168 lbs., (2) of ·0625 of 2*s.* 8*d.* + $\cdot\dot{2}$ of 2*s.* 7½*d.* + ·8375 of £1, and reduce the result to the decimal of £7.

2. State the Rules for Division of Decimals.

(*a*) (1) What number must be subtracted from the product of 9·27 and 8·0003 to give the sum of 19, 27·9652, ·003, 5·0267, and 17·09?

(2) Shew that $\frac{1\cdot 5}{\cdot 075} \times \frac{3\cdot 25}{1\frac{1}{2}} + \frac{1\cdot 875}{2\cdot 1} \times \frac{3\cdot 5}{3\cdot 75} = 44\cdot 1\dot{6}$.

3. (*a*) My watch at 9.15 A.M. on the 30th July, 1866, was 12 mi. 57 sec. too slow, but it gains ·005 of an hour in every 7½ hrs.; how much too slow will it be at 9.15 A.M. on that day week?

(*b*) A butcher having charged ·875 of a crown too much in his bill, gave in change 12·4375*s.*; what was the amount of change which he ought to have given?

4. (*a*) *A*'s farm contains 100·46875 ac., which lacks ·28125 ac. of being ¼th as large as *B*'s; *B*'s farm exceeds 6 times *C*'s by 5·725 ac.; find the extent of the 3 farms.

(*b*) How many oranges at £·084375 a dozen ought to be given for 378 eggs at ·0625*s.* each?

5. Shew that ·629 differs less from ·62888 than ·628; state the general rule to be observed in the addition or subtraction of circulating decimals, if only a certain number of decimal places be retained.

(*a*) Find the sum of $2\cdot\dot{4}$, $\cdot\dot{3}\dot{2}$, $\cdot\dot{5}6\dot{7}$, $7\cdot 0\dot{5}\dot{6}$ and $4\cdot 1\dot{7}$, and the difference between $\cdot\dot{5}\dot{9}$ and $\cdot 7\dot{8}5\dot{4}$, each to six places of decimals.

(*b*) Multiply $3\cdot 45\dot{6}$ by $\cdot 42\dot{5}$, and divide $2\cdot 4\dot{7}\dot{2}$ by 3·4.

LVIII.

1. What advantages, and what disadvantages have decimal fractions as compared with vulgar fractions?

Which is the greater, 2·3125 of 4*s.*, or $\frac{3\frac{1}{9}}{1\frac{1}{15}}$ of $\frac{19}{120}$ of £1?

2. Simplify, expressing each result decimally,

$$(1)\ \frac{5\frac{1}{2} - \cdot042 - 2\cdot4 + 7\frac{5}{8}}{16\frac{2}{15} \div 60\frac{1}{2}};\quad (2)\ \frac{\cdot015 \text{ of } 20 + 17\cdot4 \div \cdot04}{(21\cdot7 \text{ of } \cdot09 - 1\cdot95) \text{ of } 1000}.$$

3. (*a*) Shew that a train, which travels at the uniform speed of 57 mi. an hour, goes $\cdot51458\dot{3}$ times as fast as a pigeon, which flies at the uniform speed of 6 mi. in $3\frac{1}{4}$ min.

(*b*) Find the number of inches in $2\frac{2}{5}$ of 27 po. 2 ft. $-\ \cdot30\dot{6}$ of $2\frac{1}{2}$ fur. $+\ 1\frac{3}{4}$ of ·001 of 3 mi. 25 po.

4. (*a*) Find a decimal which shall be within $\frac{1}{10000}$ of $\frac{17}{21}$.

(*b*) When a vulgar fraction in its lowest terms is reduced to a recurring decimal, state what limit there is to the number of figures in the recurring period, and why it is so. Express $1\frac{3}{5}$ of 5 oz. 9 grs. Troy as the decimal of $\cdot\dot{2}$ of $\cdot4\dot{4}\dot{5}$ of 1 lb. Avoird.

(*c*) Find the G.C.M. and also the L.C.M. of 49·383 and ·142569.

5. (*a*) A salesman bought 17·75 bus. of potatoes for £2·440625; what is the least price he must charge for 8·25 bus., so as to gain on the sale not less than the cost of $\cdot0\dot{6}$ of 1 bus.?

(*b*) *A* had £256. 17*s.* 5*d.*, which was $£43\cdot188541\dot{6}$ less than ·6 of $\cdot\dot{7}$ of 2·5 times *B*'s money. How much money had *B*? Express it as a decimal or *A*'s money.

(*c*) *A* has shares in an estate to the amount of ·25 of it, and of $\cdot\dot{3}\dot{6}$ of it. *B* has shares in the same estate to the amount of $\cdot25\dot{7}\dot{2}$ of it; find the difference in value between the properties of *A* and *B*, when $\cdot\dot{3}\dot{6}$ of the estate is worth £5000.

PAPERS (LIX—LXXII.) GENERAL PAPERS UP TO THE END OF DECIMALS.

LIX.

1. What is meant by Numeration? Express in words 1120200304. Explain the principle upon which you have obtained your result.

(*a*) A farmer sold the wheat which a field of 15 ac. produced for £380. 19*s.* 0¾*d.* at £2. 16*s.* 5¼*d.* a qr.; how many qrs. per ac. did he obtain?

(*b*) *A* and *B* are 48 mi. 5 fur. 2 po. 12½ ft. apart; *A* sets out towards *B* at 8.45 A.M., and 3 hrs. later *B* sets out towards *A*; they meet at 4.45 P.M., *A* having gone over 17 mi. 3 fur. 32 po. 2½ ft. more ground than *B*. How far had each travelled, and at what average speed an hour?

2. (*a*) A cornfactor bought 30 qrs. of wheat, and sold it for £89, making a profit of £18 on his purchase; what did he give for the wheat per bus.? If he reserve 2½ qrs. of it for his own use, and sell the remainder so as to make a profit of £18. 2*s.* 11*d.*, what price per bus. must he charge?

(*b*) What is the least number of nuts a bag must contain, so that they can be distributed in parcels of 3, 4, 5, 6, 7, 8 or 9, and leave 2 nuts remaining in the bag?

3. (*a*) What is the difference between fifteen and a fifth, and fifteen fifths?

(*b*) Add together the sum, difference, and product of $9\frac{1}{16}$ and $1\frac{1}{4}$ of $\frac{3}{5}$ of $\frac{2}{7}$ of $2\frac{1}{2}$.

(*c*) The value of $\frac{3}{5}$ of $\frac{1}{3\frac{1}{2}}$ of $2\frac{1}{2}$ of a brewery being 6000 guineas; find the value of (1) $2\frac{5}{11}$ of $2\frac{1}{5}$ of $\frac{5}{36}$ of it, (2) of the brewery.

4. (*a*) Divide 7·619 by ·0019, and multiply the quotient by $\frac{3}{23}$ of ·00011569.

(*b*) If £1 = 25 fr. 25 c., express a franc as the fraction and also as the decimal of a guinea.

(*c*) Divide 50 into two parts, such that one shall exceed the other by 6·75.

5. (*a*) A man and a boy working together can do $\cdot 6\dot{1}$ of a piece of work in two days; the man working by himself could have done the work in 4 days; how many days will it take the boy working by himself to do it?

(*b*) If 120 men can make an embankment $7\cdot\dot{6}$ mi. long in 100 days, working 12 hours a day, how many hrs. a day must 160 men work, in order to finish a similar embankment 2·875 mi. long in 40 days?

LX.

1. Explain how any number may be divided by $33\frac{1}{3}$ in one line. Ex. $663072 \div 33\frac{1}{3}$.

(*a*) A quarterly gas account averaged 9500 cub. ft. at 4*s*. $7\frac{1}{2}$*d*. per 1000 cub. ft.; what was there to pay? What will be saved next year, if 1500 cub. ft. less be burnt each quarter, and the price of gas be raised $8\frac{1}{4}$*d*. per thousand cub. ft.?

(*b*) Bought paper at 16*s*. 5*d*. per ream, which was sold at the rate of $\frac{3}{4}$*d*. per sheet. Find (1) the gain on 15 reams. (2) What will be gained on each quire, if all the paper be sold for £13. 5*s*.?

2. (*a*) Gold, of the value of £500000, arrives from California; what is its weight avoirdupois, the price being £3. 18*s*. per oz. Troy?

(*b*) Find, by Practice, the value (1) of $246\frac{3}{8}$ cwt. of sugar at £3. 10*s*. 6*d*. a cwt., (2) of 3 qrs. $5\frac{27}{32}$ bus. at £1·925 a qr.

3. What is meant by reducing one quantity to the fraction of another?

(*a*) Simplify:

(1) $$\frac{\frac{3}{4} \text{ of } \frac{4}{25} \times 5\frac{1}{3}}{\frac{3}{5} \text{ of } 2\frac{1}{7} \times 3\frac{1}{2}} - \frac{3\frac{1}{5} \text{ of } \frac{5}{21}}{3\frac{1}{3} \text{ of } 4\frac{1}{5}}.$$

(2) $8\frac{3}{10} - 1\frac{1}{9}$ of $2\frac{5}{20}$ of $1\frac{1}{5} + 2\frac{1}{2}$ of $4\frac{2}{3} - 7$.

(3) $8\frac{3}{10} - 1\frac{1}{9}$ of $2\frac{5}{20}$ of $(1\frac{1}{5} + 2\frac{1}{2})$ of $4\frac{2}{3} + 37$.

(*b*) (1) How often can 3 yds. 1 qr. $2\frac{1}{3}$ in. of ribbon be cut off from $\frac{2}{3}$ of a piece of ribbon, which measures 51 yds. 3 nls.? (2) What fractional part of the whole piece will be left?

4. (*a*) If a family of 26 persons consume $145\frac{1}{32}$ lbs. of butter in 4¼ wks., what will be the average daily cost of each person's consumption, if butter be 1*s*. 8*d*. per lb.?

(*b*) *A* earns 2*s*. 6*d*. a day; what ought he to be paid for digging a garden, it being given that *A* and *B* can dig one $2\frac{7}{12}$ times, *A* and *C* one $2\frac{1}{12}$ times, and *A*, *B*, and *C* one $3\frac{1}{3}$ times as great as the given one in a week?

5. How do Decimals differ from Vulgar Fractions?

(*a*) What must be added to the product of the difference between 2 and 6 hundredths, and 164 ten-thousandths, and the sum of 4 thousandths, 2 and 8 hundredths, 5 and 8 tenths, to make the result $= 100{\cdot}08 \div 5{\cdot}004$?

(*b*) Reduce $\frac{5}{9}$ of 16*s*. 4⅓*d*. to the decimal (1) of £1, (2) of £1. 9*s*. 10¼*d*.

(*c*) Find in inches and fractions of an inch the value of $\cdot 000\dot{3}55113\dot{6}$ of a mile, and give reasons for the process employed.

LXI.

1. (*a*) Employ short division in dividing 195477 by 7920. Write down the remainder, and compare the process by which 195477 inches may be reduced to furlongs, &c.

(*b*) I wished to give a certain number of old men 1*s*. 8*d*. each, and I found that I had not money enough in my purse by 11*s*.; so I gave them 1*s*. 5*d*. each, and then I had money enough, and 3*s*. 3*d*. to spare; find the number of old men.

2. (*a*) If 4 men with 7 women earn £5. 9*s*. in a week, and 5 men and 2 women earn £4. 9*s*. in the same time, in what time will 3 men and 3 women earn £66?

(*b*) July 1, 1866 fell on a Sunday; a labourer during that month earned £3. 4*s*. 7½*d*. in hoeing turnips at 3*s*. 8*d*. an ac.; he was idle 2½ days. How much land did he hoe on the average per day?

3. (*a*) A man, who had to walk from Glaston to Stoke Dry (4½ miles), has gone 3 mi. 20 po. 2 ft. What fractional part of the whole distance had he to walk?

(*b*) *A* owns $\frac{5}{13}$ of a bin of barley, *B* the rest; $\frac{2}{3}$ of the diff. between their shares is 5 qrs. 7 bus. Find *B*'s share.

4. (*a*) Simplify:

(1) $$\left(2\tfrac{17}{20}-\frac{13}{15}+1\tfrac{7}{10}-\frac{4}{5}\right)\div\left(1\tfrac{1}{2}\text{ of }5-\frac{1}{2}\text{ of }\frac{1}{3}\right).$$

(2) $$\left\{2\tfrac{17}{20}-\left(\frac{13}{15}+1\tfrac{7}{10}\right)+\frac{4}{5}\right\}\div\left\{1\tfrac{1}{2}\text{ of }\left(5-\frac{1}{2}\right)\text{ of }\frac{1}{3}\right\}.$$

(3) $$\cdot\dot{6}\text{ of }3\cdot3+\frac{1\cdot75}{2\cdot625}\text{ of }17+\cdot4\text{ of }5\cdot75-\frac{1\cdot\dot{7}1428\dot{5}}{2\cdot\dot{0}9523\dot{8}}.$$

(*b*) (1) What number divided by 1·25 will give the product of 11 × 1·1 × ·0011? Prove the truth of each step by fractions.

(2) Divide 12·003 by 54·1 to three places of decimals, and prove the truth of the result.

5. (*a*) Find the value of 2 tons, 8 cwt. 1 qr. 15 lbs. at £2. 13*s*. 8½*d*. a cwt.: also turn the question into one of multiplication of decimals, and compare the two methods.

(*b*) If by selling a pig for 10*s*. 6*d*., $\cdot\dot{3}$ of its cost price is gained, what decimal part of the cost price would be gained, if it be sold for 12*s*.?

LXII.

1. (*a*) A coal merchant bought some coal for £86. 16*s*.; he sold 84 tons of it at 15*s*. 10½*d*. a ton, and the remainder at 10½*d*. a cwt., and gained £4. 7*s*. 6*d*. by his bargain. How many tons did he buy?

(*b*) A draper bought 4 pieces of calico of equal lengths at 10¼*d*. a yd.; by selling 2 of the pieces for £8. 6*s*. 8*d*., the 3rd for £5. 3*s*. 4*d*., and the 4th for £3. 6*s*. 8*d*., he gained £3. 3*s*. 4*d*. How many ells did each piece contain?

2. (*a*) Given that the sum of the div^{r}. and quot^{t}. = 33600; also that the quot^{t}. = div^{r}. × 15, and that the rem^{r}. = div^{r}. ÷ 15; find the dividend.

(*b*) Distinguish between Prime and Composite numbers. Shew that an odd number is not divisible by an even number.

Write down the prime factors of 464, 825, 999, and 2366.

3. (*a*) Define the L.C.M. of a fraction. How do you find it? Find the L.C.M. of $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$ and $\frac{8}{9}$; also of $\frac{7}{9}$, $\frac{22}{27}$ and $\frac{28}{45}$.

(*b*) Which is the greater $\frac{2}{3}$ of $1\frac{6}{13}$ or $\frac{3}{4}$ of $1\frac{3}{16}$?

Multiply their difference by $(8\frac{7}{20} + 7\frac{1}{4}) \div 2$.

Explain the reason of each step in the operation.

4. (*a*) If a kilometre be taken to be $\frac{5}{8}$ths of a mile, reduce 17 mi. 6 fur. 82 yds. $1\frac{1}{3}$ ft. to metres and its multiples.

NOTE. 1 kilom. = 10 hectom. = 100 dekam. = 1000 met.

(*b*) Find the value of 27 yds. 2 ft. 9 in. of one material, if 17 yds. 1 ft. 11 in. of another worth $\frac{1}{7}$th as much again cost £5. 5*s*. 10*d*.

5. (*a*) What are circulating decimals? What fractions are convertible into terminating decimals? Reduce

$$\left(\frac{2\frac{3}{4}}{5\frac{1}{2}} \div \frac{3\frac{1}{3}}{2\frac{1}{4}}\right) \times 1\tfrac{4}{5} \text{ of } \tfrac{1}{2} \text{ to a decimal.}$$

(*b*) A vessel, containing 21·84375 barrels of beer, is emptied by a pitcher which contains when full ·078125 gallon. How many times can the pitcher be filled entirely, and what fraction of a pint will it contain when the last quantity of beer is poured into it?

(*c*) A woman has a certain number of eggs: she sells $\cdot\dot{3}$ of the number and one more to one person, $\cdot\dot{3}$ of the remainder to a 2nd person, ·5 of the remainder to a 3rd person; after these sales she has 15 eggs left. How many had she at first?

LXIII.

1. (*a*) If 49 be added 101 times to itself, by how much will the result fall short of 5000? and if 17 be subtracted from 138 as often as possible, what will finally remain?

Explain fully each step of the operations.

(*b*) Reduce £420. 6*s*. $1\frac{1}{2}$*d*. to dollars and cents, a dollar being worth 4*s*. 2*d*. and a cent one hundredth part of a dollar.

2. How many sq. yds. are there in 1 ac., how many sq. yds. in 1 mi.? How many chs. in 1 mi.?

(*a*) How many sq. in. are there in 5 ac. 3 ro. 11 po.? If a plot of ground contained this number of sq. in. and the same number of sq. ft., how many ac., ro. and po. would it contain?

(*b*) If 20 men, 40 women and 50 children receive £350 for 7 weeks' work, and 2 men receive as much as 3 women or 5 children, what sum can a woman earn a week?

3. (*a*) Find the greatest sum of money of which £205. 15*s*. 3*d*. and £594. 0*s*. 9*d*. are integral multiples.

(*b*) Explain the meaning of such a fraction as

$$\frac{5 \text{ bus. } 3\tfrac{1}{2} \text{ pks.}}{2 \text{ qrs. } 1 \text{ pk. } 3 \text{ pts.}}.$$

(*c*) *A*, *B* and *C* own an estate of 6943 ac. 3 ro. 5 po.; *A* owns $\frac{18}{85}$ of it; *B* owns $\frac{11}{63}$ of it less than what *C* owns. (1) What number of ac. &c., do *A*, *B* and *C* own respectively? (2) Express *C*'s share as a fraction of *A*'s share. (3) How much is *A*'s share worth more than *B*'s share, if the land be worth £50 an ac.?

4. (*a*) Reduce to their simplest forms

$$(1)\quad \frac{2\tfrac{3}{4}+3\tfrac{2}{5}}{4\tfrac{1}{5}+5\tfrac{1}{4}} - \left(\frac{3}{5} \text{ of } \frac{7}{8}\right) \div \frac{16}{21} + \frac{2}{5} \text{ of } \frac{3\tfrac{2}{9}}{10\tfrac{1}{2}}.$$

$$(2)\quad \frac{3\tfrac{1}{2}+2\tfrac{1}{3}-1\tfrac{1}{4}}{2\tfrac{1}{2}+3\tfrac{2}{3}-4\tfrac{1}{4}} \div \frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\frac{1}{2\tfrac{1}{2}}+\frac{1}{3\tfrac{1}{3}}-\frac{1}{3\tfrac{2}{3}}} \times \frac{\frac{4}{9} \text{ of } 4\tfrac{1}{2}}{\frac{3}{5} \text{ of } 5\tfrac{1}{2}}.$$

(*b*) If *A* be $\frac{1}{5}$ of $6\frac{2}{3}$ of *B*, and *C* be $\frac{3}{4}$ of $2\frac{2}{7}$ of *B*, find the value of *A*, the value of *C* being $2\frac{1}{2}$ guineas.

5. (*a*) How many times is 6·3 of 2·007 contained in ·375 of 74·679215625?

(*b*) Find the value of 17·875 ells – 4·65625 yds. – $1{\cdot}26741\dot{6}$ of 7 yds. 3 nls.

(*c*) The discharging pipe of a cistern empties in a given time $\cdot\dot{3}$ of what the receiving pipe would fill in the same time. Given that the receiving pipe would fill the cistern, if empty, in 12·45 hrs., and that it has been running 3·75 hrs., when the discharging pipe also is set to work, find in what time the cistern will be filled.

LXIV.

1. (*a*) A man lays out £50 in buying eggs at $11\frac{1}{4}$*d*. per dozen, and sells them at 2*d*. each: what does he gain?

(*b*) A grocer mixes 13 lbs. of tea at 3*s*. 4*d*. a lb. with 5 lbs. at 4*s*. 10*d*. a lb. At what price must he sell the mixture so as to gain $1\frac{3}{4}$*d*. on each lb.?

2. (*a*) Subtract seventy thousand and eighty nine from one hundred thousand and ten, and subtract the difference from the sum of the same two numbers.

(*b*) Multiply 743089 by 2065, and deduce from the result the product of 743089 by 20652065.

3. (*a*) A merchant buys 469 qrs. 2 bus. 3 pks. 1 qt. of wheat at £2. 13*s*. 4*d*. a qr.; he divides the grain into 121 equal portions; what must he charge for each portion, in order that he may gain $\frac{1}{2}$*d*. a pint?

(*b*) (1) A merchant has in his cellar 14 casks of wine, each containing 5 hectolitres 7 dekalitres and 6 litres each; how many litres of wine has he got? If a litre be equal to a pint and three quarters, how many tuns of wine are there in his cellar? Note, 1 hectol. = 10 dekal. = 100 lit.

(2) Find the value of the above wine at 1 fr. 65 c. a litre. Reduce the result to English money, considering a sovereign to be equal 24 fr. 75 c.

4. (*a*) Define the G. C. M. of two or more fractions. How do you find it? Find the G. C. M.

(1) of $\frac{4}{9}$, $\frac{14}{27}$, and $\frac{32}{45}$. (2) of 4, $2\frac{2}{9}$, $2\frac{2}{5}$, and $2\frac{2}{45}$.

(*b*) (1) Subtract the least of the foll^{g} fract^{ns}, $\frac{5}{12}$, $\frac{1}{3}$, $\frac{7}{15}$, $\frac{3}{8}$ from the greatest, and the sum of the two least from the sum of the two greatest, and reduce the diff^{ce} of these two diff^{ces} to its lowest terms. Explain the reason of each step in the several operations.

(2) Find the difference between $2\frac{1}{5}$ and $2\times\frac{1}{5}$, and between $\frac{1}{3}$ of $2\frac{1}{5}$ and $\frac{1}{3}$ of $2+\frac{1}{5}$.

5. (*a*) What part of 3 mi. is $\left(\frac{11}{30}-\frac{4}{105}+\frac{11}{15}\right)$ths of a yd.? Explain fully the meaning of the answer.

(*b*) (1) Multiply 35·28 by ·000032, and write down from the result the product of ·3528 by 32. (2) Divide 55992·31 by 66·44, and write down the quotient of 559923100 by ·06644. (3) Divide 4·1 by $\cdot 1\dot{1}\dot{2}$.

(*c*) At a certain School Examination, ·375 of the children were examined in Scripture History, $\cdot\dot{3}$ in Arithmetic, $\cdot 208\dot{3}$ in grammar, and the remainder, 12 in number, in reading. Find the number of children in the school.

LXV.

1. What is the difference between Simple and Compound Practice?

(*a*) Find, by Practice, the cost of 4685½ lbs of butter at 1*s*. 7⅞*d*. a lb., and the cost of 39 oz. 16 dwts. 18 grs. of silver at 9*s*. 10*d*. an oz.

(*b*) How many heifers must a person buy at £8. 10*s*. each, so that after allowing 3*s*. 8*d*. for the food of each for a week, he may then by selling each of the lot at £9. 4*s*. 7*d*. gain £43. 2*s*. 5*d*.?

2. (*a*) A boy has £15 given him, out of which he is to buy 169 yds. of cord at 1¼*d*. a yd., 59½ lbs. of sugar at 5½*d*. a lb., 17½ lbs. of hops at £9. 16*s*. a cwt., and 2 qrs. 3 pks. of malt at £2. 17*s*. 4*d*. a qr., and to pay a bill of £1. 3*s*. 8½*d*. He is to bring home the change in shillings, fourpences and pence, the same number of each coin. How many of each will he have to bring?

(*b*) The wages of 18 workmen amount to £79. 4*s*. for 22 days; what will the wages of 25 apprentices amount to in 45 days, if for every 2*s*. 6*d*. that a workman receives, an apprentice receives 2*s*.?

3. Shew that the value of a Vulgar Fraction is not altered, if its numerator and denominator be each divided by the same fraction. Take as an Ex. $\frac{5}{6} = \dfrac{5 \div \frac{3}{4}}{6 \div \frac{3}{4}}$.

(*a*) (1) Find the least sum of money which can be paid in pence, shillings, florins, half-crowns, crowns, sovereigns and guineas.

(2) A merchant has 3 kinds of claret; of the first kind 269½ gals., of the second 231 gals., of the third 256⅔ gals.; he wishes to ship the claret without mixing it in full casks of equal size. How many casks must he procure?

4. (*a*) What number increased by $\left(\frac{1}{3} + \frac{2}{5} + \frac{1}{8}\right)$ of itself will equal 2007 diminished by $\frac{2}{3}$ of itself?

(*b*) A lady ordered of a shopman $\frac{1}{4}$ of a roll of silk, containing 57½ yds., at 6*s*. 3¼*d*. a yd.; he, by mistake, cut off

$\frac{1}{8}$ of the roll, charging her however for the quantity she had ordered. Of how much money did he cheat himself?

5. State the Rule for pointing in the multiplication of Decimals.

(*a*) Divide 1080 by ·008, and ·084035 by 34·3, and find the difference between the two results.

Prove the truth of each step by Fractions.

(*b*) Into how many equal parts must ·41$\dot{6}$ be divided, that 4 of such parts may amount to ·$\dot{3}$?

(*c*) If a snail crawl on the average 5½ in. in 5 min. 3 sec., what fraction and also what decimal of a mile would it crawl in 2·4 hrs.?

LXVI.

1. (*a*) Distinguish between prime numbers and numbers prime to one another.

Resolve into prime factors 60, 126, 1960; also find their L. C. M.

(*b*) A purse and its contents are worth £3. 6*s*. 5½*d*., 9 times the value of the contents = twice the value of the purse. Find the value of the contents of the purse.

2. (*a*) The debts of a company are seven millions and a half sterling, and its assets are four millions six hundred and eighty-seven thousand five hundred pounds. How much can the company pay in the pound, and what will be the debt on which they can pay £1466. 12*s*. 9¾*d*.?

(*b*) (1) *A*, *B* and *C* started together on a journey of 36 miles at 9.15 A.M. *A* completed the distance at the rate of 3¾ mi. an hour, *B* walked the first half of the distance at 3 mi. an hour, and the other half at 4 mi. an hour, *C* was walking half his time at the rate of 3 mi. an hour, and the other half at 4 mi. an hour. Find in what order they came in.

(2) How far was the man who came in last from the end of his journey, when the first man reached it?

3. What is the expression $\frac{5}{27}$ of $2\frac{5}{8}$ called? Reduce it to the simplest fraction, and explain fully each step of the operation.

(*a*) Simplify: (1) $\dfrac{1-\dfrac{1\frac{1}{2}}{2\frac{1}{2}}}{\dfrac{3}{5}}$ of $\dfrac{1-\dfrac{1}{3\frac{1}{2}}}{\dfrac{5}{7}}$.

(2) $\dfrac{\frac{1}{2}-\frac{1}{3}}{\frac{1}{3}-\frac{1}{4}}$ of $\dfrac{\frac{1}{4}-\frac{1}{5}}{\frac{1}{5}-\frac{1}{6}}$ of $\dfrac{\frac{1}{6}-\frac{1}{7}}{\frac{1}{7}-\frac{1}{8}}$; (3) $\cdot 1\dot{5}+\cdot 2\dot{5}+\cdot 03\dot{5}$.

(*b*) If a plot of ground, 1 mile square, be divided into 750 equal plots, what will be the size of each plot, and what part of an acre will it contain?

4. (*a*) (1) Express £57. 16*s*. 0¾*d*. in florins, cents, and mills, and also in francs and centimes, if £1 = 10 fl. = 100 c. = 1000 mills = 24 fr. 85 c.

(*b*) Find the value (1) of $\dfrac{2\frac{1}{5}}{5\frac{1}{2}}$ of $\cdot 000\dot{3}$ of 600 guineas.

(2) of $\cdot\dot{5}\dot{4}$ of $\cdot 30\dot{2}\dot{7}$ of 7 fur. 6 po.

5. (*a*) A man having £11. 14*s*. 9½*d*. in his pocket, gave ·4 of it for 1·75 cwt. of beef. What was the value of the beef per lb.?

(*b*) A farmer bought 50 animals, sheep, lambs, and pigs, for £63; there were 3 times as many lambs as sheep, and twice as many pigs as lambs; the sheep cost twice as much per head, and the pigs $\frac{2}{3}$ as much per head as the lambs. How many animals of each kind were bought, and at what price?

(*c*) If *A* can do as much work in 5 hrs. as *B* can do in 6 hrs., or as *C* can do in 9 hrs., how long will it take *C* to complete a piece of work, $\frac{3}{4}$ of which has been done by *A* working 12 hrs. and *B* working 24 hrs.?

LXVII.

1. Explain the process of dividing one number by another by long division, by taking 50003501 ÷ 1680 as an Ex.

Split 1680 into its prime factors, and shew that the same result is obtained whether you divide by 1680, or by its prime factors in succession.

How may any number be multiplied by 231333 in three lines?

2. (*a*) What is the price of lead per cwt., if the sale of 48 cwt. at £45. 11*s*. 3*d*. give a profit of £12. 10*s*. on every £100 of outlay?

(*b*) I bought 19 rabbits at 2*s*. 7½*d*. a couple, three of them died; I kept the rest for 7 weeks at a cost of $7\frac{1}{2}$*d.* a fortnight; at what price must I sell them each to gain 7*s.* $10\frac{1}{2}$*d.* on my outlay?

(*c*) A boy had 7*s.* 6*d.* given to him; he spent $\frac{1}{9}$ of it in ginger beer, $\frac{1}{12}$ of it in buns, $8\frac{1}{2}$*d.* of it in sugar-candy; the rest he divided as far as he could among his 3 brothers and 4 sisters, giving each sister half as much more as each brother; he gave what then remained to a poor old woman. What did she get?

3. (*a*) The carriage of 1 cwt. 3 qrs. 21 lbs. for $52\frac{1}{4}$ miles comes to 17*s.* 5*d.*, what will be charged for $2\frac{1}{2}$ tons for $46\frac{1}{2}$ miles?

(*b*) A person has shares amounting to $\frac{2}{9}$ of a property, which is worth £124. 14*s.* 11*d.*, and after purchasing additional shares worth $\frac{1}{8}$ of his own, he sells $\frac{1}{13}$ of his whole interest in the property. What share has he left, and what is it worth?

4. (*a*) How many francs should be given in exchange for $\dfrac{3\frac{1}{4} \text{ of } 4\frac{1}{3}}{\left(2\frac{1}{2}-\frac{1}{3}\right) \text{ of } \left(3\frac{1}{2}-\frac{1}{4}\right)}$ of £5. 12*s.* 6*d.*, if £1 = 25·24 fr.?

(*b*) Simplify (1) $2\frac{1}{2}+2\frac{1}{8}+(3\frac{3}{8}-2)$ of $4\frac{1}{2}-4\frac{2}{3}$ of $(2\frac{1}{4}-1\frac{1}{2})$.

$$(2)\ \frac{1}{4}+\frac{7}{8} \text{ of } \left(\frac{2\frac{1}{3}}{3\frac{1}{2}}+\frac{4\frac{1}{2}}{5\frac{1}{4}}\right)-\frac{\frac{2}{7}-\frac{1}{3} \text{ of } \left(\frac{1}{2}+\frac{1}{7}\right)}{1+\dfrac{1}{2-\frac{1}{4}}}.$$

5. (*a*) Find the value of $\frac{3}{4}$ of $\frac{1}{9\frac{1}{3}}$ of £1. 18*s.* + $\frac{2}{3}$ of ·375 of 15*s.* + $\frac{2}{5}$ of $\cdot4\dot{2}\dot{9}$ of 8*s.* 3*d.*

(*b*) *A* and *B* run a race, their rates of running being as 17 to 18; *A* runs $2\frac{1}{3}$ miles in 16′ 48″; *B* finishes the course in 34′. Find the length of the course.

(*c*) *C* owes *B* ·875 of what *B* owes *A*, *B* gives *C* 6*s.* $8\frac{1}{4}$*d.* to put the accounts between them all straight. What was *B*'s debt to *A*?

LXVIII.

1. (*a*) A farmer invests £112. 12*s*. in two kinds of wheat, one at 45*s*. 6*d*. a qr., the other at 38*s*. 8*d*. a qr. He mixes them in the proportion of 5 of the cheaper to 4 of the dearer. How much will he gain or lose by selling the mixture at 43*s*. 6*d*. a qr.?

(*b*) A bankrupt pays 5 fl. 7 c. 5 m. in the £; what sum will be lost on a debt of 2015 guin^s?

2. Shew by diagrams the difference between a lin^r. yd., a sq. yd., and a cub. yd. Shew by the last diagram how many cub. ft. = 1 cub. yd.

(*a*) Divide the difference between 300 times 6 ac. 6 po. 7½ sq. yds. and 16 times 16 ac. 2 ro. 11¼ sq. yds. among *A*, *B* and *C*, giving *B* four times *A*'s share, and *C* as much as *A* and *B* together.

(*b*) Three lines of paling run side by side for a distance of 150 yds. The upright posts are respectively 2½, 3⅓, 4⅙ ft. apart. How often will a person walking outside be able, on looking across, to see 3 posts in a line?

3. What is meant by 10^2, 10^3, 10^5? What are the figures 2, 3, 5 called?

(*a*) Simplify

(1) $$\frac{5-\frac{5}{9}}{3\frac{1}{4}+\frac{1}{2}\text{ of }1\frac{2}{3}} \div \left(\frac{1-\frac{1}{2}}{1+\frac{1}{2}}\right)^2,$$

(2) $$\left\{\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{5}\text{ of }3\frac{1}{3}+\frac{13}{36}} - \frac{1}{2\frac{1}{2}}\right\} \div \frac{15\frac{3}{4}}{26\frac{1}{4}}.$$

(*b*) (1) Divide the product of 1·075 and ·0101 by ·43, and find which is the greater ·39 of a guinea, or $\cdot 409\dot{9}$ of £1.

(2) Shew that $1+\dfrac{1}{3\times 5}+\dfrac{1}{2\times 3\times 5^2}+\dfrac{1}{2\times 3\times 4\times 5^3}=1\cdot 073\dot{6}$.

4. (*a*) $\left(\dfrac{36\cdot 54}{4\cdot 35}-3\cdot 0\dot{0}\dot{9}\right)$ of a cheese weighs 1·6 of 37 lbs. 1 oz. Find the weight of the cheese.

(*b*) Supposing the alloy in a shilling to be $\frac{1}{13}$ of its mass, and the coin to be worth a farthing if it were all alloy, what would be its exact value if it were all pure silver?

(*c*) If 12 oxen be worth 29 sheep, 15 sheep worth 25 hogs, 17 hogs worth 3 loads of wheat, and 8 loads of wheat worth 17 loads of oats, how many loads of oats must be given for 20 oxen?

5. (*a*) A bookseller devotes a certain sum of money with its contingent profits to the purchase and re-purchase of stock. At the end of every three months he re-invests his returns. His profits are ¼th, ⅕th, ⅙th, ⅐th of his respective investments. Shew that at the end of the year his capital will be doubled.

(*b*) *A* can reap $\cdot\dot{4}$ of a field in $2\cdot\dot{6}$ days, and *B* can reap ·6 of it in 4·5 days: *A* and *B* work together till they have reaped ·75 of the field. *A* then leaves, and *B* completes the work. If *A* earn 5*s*. a day, what ought the reaping of the field to cost?

LXIX.

1. (*a*) A piece of cloth, when measured with a yard measure which is ·6 of an inch too short, appears to be 88⅓ yards long, what is its true length?

(*b*) A person having paid an income-tax of 4*d*. in the £ during the 1st half of the year, and of 3½*d*. in the £ during the 2nd half of the year, has £359. 5*s*. 11¼*d*. left. What was his gross income?

2. (*a*) How many more grains are there in 1 oz. Troy than in 1 oz. Avoird.? In standard gold, how many parts are *pure* gold? Given that 1 lb. Troy of standard gold is worth £46. 14*s*. 6*d*., find the value of 1 oz. of pure gold, neglecting the value of the alloy.

(*b*) What is the exact time between 5 and 6 o'clock, when the hour and minute hands of a clock should be (1) one exactly over the other (2) the minute hand 15 minutes before the hour hand?

3. Shew that a number is divisible by 8, if the number made up of its last three digits taken in order be divisible by 8.

Supposing a certain number of pence to be paid every day, the amount in a year will be half as many pounds again, and five times the number of pence. Explain the reasons for this. Find by this method the sum 7*d*. a day will amount to in a year.

(*a*) Miss Johnson and Mrs Stokes have between them 132 chickens; $\cdot25$ of Miss Johnson's $= \cdot\dot{1}4285\dot{7}$ of Mrs Stokes'. How many had each of them?

(*b*) A stack of hay will keep 12 cows or 9 horses for 1 week. What decimal part of a leap-year will it keep 10 cows and 6 horses?

4. (*a*) My watch at 12 o'clock (Noon) on Monday marked 12h. 10′, and at 10h. 15′ A.M. on the following Saturday 10 hr. 40 min. 36$\frac{7}{48}$ sec. Find its average rate of gain per day.

(*b*) *A* and *B* own a farm together; *A* owns $\frac{7}{12}$ of it, and *B* the remainder, and the difference between their shares is 17ac. 0ro. 20po. Find the value of the farm if $\frac{3}{5}$ of it be worth £50 an acre, and the rest of it £46 an acre.

5. (*a*) If Fanny can guess 9 acrostics while Henrietta guesses 14, and Henrietta can guess 7 while Kate guesses 9, how many ought Kate to guess in the time that Fanny guesses 30?

(*b*) The stock of food in a garrison is calculated to last 30 days; after 5 days have elapsed a sally is made, and $\frac{1}{6}$ of the men are killed; 10 days pass away and then a second sally is made, from which the garrison return, leaving a fifth of their number dead on the field. A reinforcement is now thrown in to the amount of $\frac{1}{4}$th of the present strength of the garrison, and the men are placed on half rations. Find how long they will be able to hold out.

LXX.

1. Explain the principle of Simple Subtraction.

(*a*) In the Upper School at Eton College on Election Saturday 1866 there were 745 boys. The number of boys in the 5th form exceeded 3 times the sum of the number of unplaced boys, and of those in the 6th and 4th forms by 9; the number in the 6th form = 3 times the number of unplaced less 7; the number in the 4th form = $\frac{1}{3}$ of the number in the 5th less 32. Find the number of boys in the 6th, 5th and 4th forms respectively, and the number of unplaced boys.

(*b*) In the Lower School, 1 boy was unplaced; and the difference between the number of those in the 3rd form and 1st form = 11 times the difference between the numbers of those in the 2nd form and the unplaced; also the number in the 3rd form = 9 × (number in the 2nd form + the number of unplaced): also the number in the 2nd form = twice the number in the 1st form. Find the no. of boys in the Lower School.

(*c*) The total number of boys on Election Tuesday 1865 was 819; find the increase on every hundred boys.

2. (*a*) The quick time or step, in marching, being 2 paces per second, at 28 in. each: at what rate per hr. does a company

march on a good road? And how long will they be in arriving at a garrison 20 mi. distant, allowing a halt of 1 hr. by the way for refreshment?

(*b*) Express 6·72 oz. as the decimal of $2\frac{1}{2}$ cwt., and $\frac{4}{5}$ of 3*s*. 4*d*. as the decimal of £100. Explain the process.

3. (*a*) Express decimally the value of

(1) $\frac{1}{2}+3\frac{3}{4}-\frac{5}{6}+2\frac{7}{8}-\frac{9}{10}-\frac{11}{12}$,

(2) $\dfrac{\{\frac{2}{9}+\frac{3}{8}\}\div 2}{\frac{1}{6}\text{ of }(\frac{4}{5}-\frac{1}{16})}$.

(*b*) Reduce to its lowest terms

$$\left\{1+\cfrac{1}{3+\cfrac{1}{3+\frac{1}{3}}}\right\}\div\{\tfrac{1}{3}+\tfrac{1}{11}\text{ of }10\tfrac{2}{3}\}.$$

4. (*a*) A shopkeeper bought a chest of tea containing $78\frac{3}{4}$ lbs. for £$12\frac{223}{320}$; she sold $\frac{3}{5}$ of the chest, gaining $\cdot 0\dot{6}$ of 5*s*. on each lb. sold. How much did she receive for it?

(*b*) A man sold a horse for £25, and thereby lost $\frac{1}{6}$ of his purchase money. What part of his purchase money would he have gained had he sold the horse for £40?

5. (*a*) What circulating decimal multiplied by $\dfrac{2\frac{3}{5}}{4\frac{1}{2}}$ will give 2 for a product?

(*b*) *A* can do $\frac{1}{3}$ of a job in 4 days; *B* can do $\frac{1}{4}$ of it in 5 days; *C* can do $\frac{1}{5}$ of it in 3 days, and *D* can do $\frac{1}{6}$ of it in $1\frac{1}{2}$ days; they all work at it till $\frac{7}{10}$ of the job is completed; *B*, *C* and *D* then leave, and *A* goes on by himself. How many more days will the job be in hand, than if they had all staid at their work?

LXXI.

1. (*a*) Explain the principles of the common system of numerical notation. Multiply 807 by 507, and give the reasons for the several steps. Prove the truth of the result by casting out the nines.

Shew that $8\times 6=6\times 8$.

(*b*) An equal number of guineas, pounds, half-guineas, half-crowns, shillings and sixpences make up £166. 10*s*. Find the number.

(*c*) A farmer bought a flock of sheep for £45. 10*s.*; and expected to clear £10. 16*s.* 8*d.* on every £100 of outlay by selling them at a profit of 7*s.* 7*d.* each; 3 of the sheep having died, he sold each of the others at the above-mentioned profit on their cost price. What did he lose?

2. What is meant (1) by a mean solar day? (2) by a solar year? How does it differ from a common year? How is the confusion, which would arise from this difference, obviated?

(*a*) Assuming that an express train runs 40 mi. an hr., and an ordinary train 30 mi. an hr., and that the express fare is ¼*d.* a mi. more than the ordinary, find how much an hour a man's time is worth, if it cost him the same to travel by one as by the other.

(*b*) In how many days of 12 hrs. each would 72 men do a piece of work, which 60 men can do in 30 days of 9 hrs. each?

3. (*a*) Find the value of $5{\cdot}35$ tons $+ 6{\cdot}\dot{3}9$ cwt. $+ 3{\cdot}44$ qrs.

(*b*) What fraction of $\frac{5}{17}$ of 11 qrs. 5 bus. 2 pks. is equal to $\frac{3}{8}$ of 9 qrs. 1 bus. 1⅓ pk.?

(*c*) A man owned fifty-five thousandths of a mine valued at £3000000, and sold seventy-four ten-thousandths of his share. How much did he still own, and what was it worth?

4. (*a*) A man has two kinds of beer; the 1st is worth £1. 8*s.* 6*d.* per barrel more than the 2nd, and 9 pints of the 2nd are equal in value to 6 pints of the 1st. Find the price of a gallon of each.

(*b*) A gentleman buys two farms containing 575 ac. of land each, for £42262. 10*s.* What is the average value of an acre of land in each farm, if an acre in one lot be worth 2½ ac. in the other?

5. (*a*) A cistern has 3 receiving and 2 discharging pipes; the first three will fill it in 24, 36 and 48 minutes respectively, and the discharging pipes will empty it in 40 and 50 minutes respectively. If the cistern be empty, and the 1st receiving pipe opened at 12 o'clock, at 12.5 1st discharging pipe, at 12.10 the 2nd receiving pipe, at 12.15 the 2nd discharging pipe, and at 12.20 the 3rd receiving pipe, when will the cistern be filled?

(*b*) *A* has an income $= \dfrac{\cdot 6 \text{ of } \cdot 8\dot{3}}{3{\cdot}5}$ of *B*'s income. Compare their incomes. If *A* after spending £645 per annum find that he has exceeded his income by ·075 of it, find *B*'s income.

LXXII.

1. How is (1) the Imperial Standard Yard, (2) the Imperial Standard Pound, (3) the Imperial Standard Gallon, (4) the Imperial Standard Bushel determined?

(*a*) A bankrupt's liabilities are £1878. 17*s*. 6½*d*., and he pays 15*s*. 8¾*d*. in the pound. Find by Practice his assets.

(*b*) Also find by any method you prefer the value of $5555\frac{2}{3}$ things at 6*s*. 10½*d*. each.

2. (*a*) The numbers of paupers relieved in England and Wales in the 4th weeks of May 1865 and 1866 were 878794 and 843873 respectively; shew that the decrease per cent., or on every 100, was 3.9...

(*b*) Had the numbers been reversed, what would have been the increase per cent.?

3. Shew that by an extension of the ordinary system of notation all fractions whose denominators are composed of the factors 2 or 5, or their powers only, may be expressed in the same way as whole numbers.

(*a*) Simplify

$$(1)\quad \frac{1}{3\frac{1}{5}} - \frac{2\frac{1}{4}}{9} + \frac{3\frac{5}{8}}{12} + \frac{\frac{5}{7}}{4\frac{4}{7}} + \frac{3-2\frac{1}{3}}{4-3\frac{1}{4}}.$$

(2) $\frac{3}{7}$ of $\cdot175$ of $\cdot\dot{2}8571\dot{4} \div \cdot00425$.

(*b*) What number is that, from which if you deduct the difference between $\frac{7}{8}$ and $\frac{3}{7}$, and add to the remainder the quotient of $\frac{3}{17}$ by $5\frac{1}{4}$, the sum will be $\frac{122}{357} + 10\frac{1}{12}$?

(*c*) Reduce $\frac{5}{8}$ths of 16*s*. 4½*d*. to the dec^l^. of £1. 9*s*. 10½*d*.

4. (*a*) *A*, *B* and *C* run a quarter of a mile race. *A* has 8 yds. start, *B* 2 yds. *C* gains 1 ft. in 40 yds. throughout on *A*. *B* gains 2 ft. in 25 yds. on *A* for the first 200 yds., but afterwards loses 1 ft. in 20 yds. What is the result of the race?

(*b*) *A* can walk 5 mi., while *B* is walking 4 mi. Supposing *A* to walk 6 hrs. a day, and *B* 7 hrs. a day, how many days will *A* take in walking a distance, which *B* can walk in 14 days?

5. (*a*) After a rent has been reduced $\frac{1}{3}$rd, a poor rate on it at 8½*d*. in the £ amounts to £34. Express the rate as a decimal of the original rent.

(*b*) A man takes for the expenses of a tour £20. 18*s*., and finds at the end of 6 days that the money, which he had spent, was just equal to $\cdot\dot{8}0952\dot{3}$ of what remained. Find his average daily expenses.

EXAMINATION PAPERS.

PART IV.

PAPERS (LXXIII—LXXVII) ON THE METRIC SYSTEM, SQUARE AND CUBIC MEASURE, SQUARE AND CUBE ROOT.

LXXIII.

1. Write down (1) the French tables of money and length, (2) the American table of money.

Express (1) in francs, and (2) in centimes (*a*) 25 fr. 25 c. (*b*) 9 fr. 83 c. (*c*) 54 fr. 3 c. (*d*) 309 fr. $7\frac{3}{4}$ c. (*e*) $85\frac{1}{2}$ c. (*f*) 740 fr. $\frac{1}{8}$ c.

Express (1) in kilom. and (2) in met. (*a*) 5 kilom. 5 dekam. (*b*) 27 dekam. 27 millim. (*c*) $457\frac{3}{5}$ hectom. (*d*) 28 m. 5 millim. (*e*) 24 kilom. 43 decim.

Express (1) in dollars, and (2) in cents.

(*a*) $19. 9 cents. (*b*) $74. 4 mills. (*c*) 15 dimes 7 mills. (*d*) 84 mills. (*e*) $8\frac{3}{4}$ mills.

2. Calculate the following bills:

(*a*) $54\frac{1}{2}$ m. of silk at 6 fr. 25 c. a m., 27 m. 54 millim. of calico at 94 c. a m., 84 m. 5 millim. of flannel at 2 fr. 5 c. a m., 13 m. 7 decim. of lining at 75 c. a m.

(*b*) 13 lbs. 3 oz. of cheese at $13\frac{1}{2}$ cents a lb., 17 lbs. of tea at 50 cents a lb., $14\frac{3}{4}$ yds. of linen at $84\frac{1}{2}$ cents a yd., a barrel of beer at $6\frac{3}{4}$ cents a pint, 18 yds. of cloth at $3\frac{1}{2}$ dollars a yd.

3. (*a*) I bought 6 dozen of pigeons for 86 fr. 40 c.; how much less should I have paid for each, had I bought 8 more for the same money?

(*b*) A draper bought 3 pieces of cloth, each containing 35 met. 75 centim. at 11 fr. 15 c. a m.; he sold $\frac{1}{5}$ of it at 12 fr. 50 c. the m., and the rest he cut into pieces each measuring 78 decim., and sold each piece at 90 fr. 5 c. What did he gain?

(*c*) How many pecks of apples can be bought for $13 60 cents at 34 cents a bushel? What decimal of a dollar would purchase a peck?

4. Define (1) the square of a given number, (2) the square root of a given number. How are they expressed?

(*a*) Find the value of (1) $(\frac{5}{7})^2$, (2) $(2{\cdot}0001)^2$, (3) $(1\frac{3}{4})^2$.

(*b*) Find the sq. root of (1) 263169, (2) 4426816, (3) $9\frac{3}{4}$.

(*c*) A gardener wishes to plant an orchard with 7225 trees, and to arrange the trees, so that the number of rows of trees shall be equal to the number of trees in each row. Find the number of trees in each row.

5. What is (1) a straight line? (2) a right angle? (3) a square? (4) an oblong or rectangle? Explain by means of a diagram how it is that 3 lin^{r}. ft. × 5 lin^{r}. ft. = 15 sq. ft.

(*a*) A person bought a plank containing 76 sq. ft.; the plank was 1 ft. 7 in. in width: what was its length?

(*b*) What will it cost to paper a room 14 ft. 8 in. long, 12 ft. 8 in. broad, and 11 ft. 7 in. high, at 9 cents per sq. yd.?

(*c*) It is required to lay out 790 sq. m. 73 sq. decim. 44 sq. centim. of land in the form of a rectangle, whose length shall be 4 times its width; find the length.

LXXIV.

1. (*a*) Make out the following bill: 2 lbs. of sugar at 14 cents 9 mills a lb., $14\frac{1}{2}$ lbs. of cheese at $17\frac{1}{2}$ cents a lb., 7 lbs. 4 oz. of butter at \$·245 a lb., $5\frac{3}{4}$ lbs. of tea at $39\frac{1}{2}$ cents a lb., 40 eggs at 27 cents a dozen, 12 lbs. of currants at \$15. 12 cents a cwt. Find the value in English money, if \$1 = 4*s*. 2*d*.

(*b*) If 1 kilom. $=\frac{5}{8}$ of a mile, how many turns will a wheel take in 20 mi., the circumf^{ce}. of the wheel being 4 m. 5 millim.?

2. Explain the reason of pointing in extracting the square root of a whole number.

(*a*) Find the sq. root of (1) 3486·784401; (2) 8; (3) $17\frac{3}{8}$, each of the two latter to 4 places of decimals.

(*b*) How many rods of fencing will be required to enclose a square field of 40 acres?

3. What is meant by area? How is it measured arithmetically? Define (1) a plane rectilineal angle; (2) a plane triangle. Distinguish between the different kinds of (1) angles, (2) triangles.

(*a*) What will be the cost of carpeting a room 48 ft. long, and 33 ft. 9 in. wide, with carpet ·75 yd. wide, at 4*s*. 6*d*. a yd.?

(*b*) What are duodecimals? Find by duodecimals, and also by fractions, the product of 6 ft. $7' 8''$ by 2 ft. $9'$, and shew that the results coincide.

4. (1) Write down the French Table for Weights. What number of lbs. English = 1 kilog.?

Multiply (1) by 100 and (2) by 100000 (*a*) 3 fr. 5 c. (*b*) 27 c. (*c*) 5 hectom. 7 decim. (*d*) 15 myriam. 17 centim.

(2) Express in terms of a kilog. and also of a decig. (*a*) 17 dekag., (*b*) 53 myriag. 250 decig. (*c*) $15\frac{1}{2}$ millig. (*d*) 503·0057 gr.

(3) A person bought 15 chests of tea, each containing 86 kilog. 37 gr., at 315 fr. 4 c. a chest, and retailed the tea at the rate of 20 grs. for 25 c. Did he gain or lose? How much?

5. Define the cube root of a number. Find the value of $(5\frac{4}{5})^3$.

(*a*) Extract the cube root of (1) 405224; (2) 529475129.

(*b*) The pedestal of a statue, having a square base, each side of which is $28\frac{1}{2}$ inches, contains $10356\frac{3}{16}$ solid inches. Find the height of the pedestal.

6. What is the altitude of a figure?

(*a*) A house, 46 ft. high, is built upon the bank of a river, 59 ft. wide. How long must a ladder be, which will reach from 1 ft. outside the edge of the river, to a point in the wall of the house on the other side, which is 1 ft. from the top?

(*b*) The area of a triangular field, whose base = twice its altitude, is 400 sq. yds. Find its base.

LXXV.

1. State the rule for pointing in extracting the cube root of a decimal.

(*a*) Extract the sq. root of (1) 160048·0036, (2) $\frac{2}{25}$ to 4 places of decimals.

(*b*) Extract the cube root of (1) ·000000003375, and (2) of $7\frac{6}{7}$ to 2 places of decimals.

2. Define a Parallelogram. What is the perimeter of a figure?

(*a*) A room, 17 ft. 6 in. in length, requires 25 yds. 8 ft. 48 in. of carpet to cover it; find the width of the room. 13 ft 4 in

(*b*) A room is 15 ft. 6 in. long, by 13 ft. 4 in. wide, and 10 ft. 6 in. high. Find the expense of papering the walls with

£2 10 5½d

5 18 12

paper, 2 ft. 6 in. wide, at 7½*d.* a yd., and also of covering the floor with carpet, $\frac{7}{8}$ yd. wide, at £·225 a yd.

(*c*) The base of a parallelogram is 27 chains, and its altitude is 32 rods; find its area. 21 ac 2 ro 16 po

3. Write down the Metric Tables of Surface and Solidity. What are the respective values of a hectare and of a stere in English measure?

(*a*) If the driving-wheel of a locomotive be 1 dekam. 25 decim. in circumference, and it makes 2½ revolutions in 1 second, how long will it take to travel 100 miles, if 1 mile = 1⅝ kilom.?

(*b*) Two masons' wages, for 7 days' work of the 1st, and 5 days' work of the 2nd, amount to 45 fr. 90 c., and for 5 days' work of the 1st, and 7 days' work of the 2nd, to 48 fr. 66 c. Find the daily wages of each.

(*c*) How much less than 55 hectares is a rectangular field, whose length is 57 dekam. 5 decim., and breadth 86 m. 24 centim.?

4. (*a*) If 38 kilog. 25 grs. of sugar cost 134 fr. 7½ c., how much sugar worth $\frac{5}{6}$ as much per dekag. can be bought for 26 fr. 81⅓ c.?

(*b*) Divide $47. 50 cents among *A*, *B* and *C*, so that *B* shall have $\frac{2}{3}$ of *A*'s share, and *C* $\frac{2}{3}$ of *B*'s share. B = 15
C = 10

5. (*a*) What will it cost to make a gravel walk, 7 ft. wide, along the sides of a square field, containing 2½ ac., at 1*s.* 3*d.* a sq. yd., the walk being part of the field? 62 16 1

(*b*) A cubical block contains 4 cub. ft. 1088 cub. in.; find the number of sq. yds. &c. in its surface.

1 sq y 7 ft 96 in

LXXVI.

1: (*a*) If I buy a pipe of wine at $2. 5 cents. a gallon, and retail ⅝ of it at 27½ cents. a pint, and the rest at 18 cents. a pint, shall I gain or lose? How much? 7 [illegible] lose

(*b*) A square field contains 10 ac.; find within an inch the distance between the opposite corners.

2. (*a*) Divide $\frac{14}{15}$ of a roll of ribbon, containing $49\frac{3}{7}$ m., into equal parts, each of which shall contain $\cdot0\dot{4}$ of the whole roll.

(*b*) Work by cross multiplication, and also by fractions, 36 ft. 9′. 4″ multiplied by 26 ft. 6′. 9″, and shew that the results agree.

(*c*) The length of a room is 14 ft.; the cost of painting the walls at 2*s*. 7½*d*. per sq. yd. is £7. 11*s*. 8*d*., and the cost of carpeting the room at 4*s*. a sq. yd. is £3. 14*s*. 8*d*. Find the height and also the breadth of the room. 4 yds 3 yds 1 ft

3. Write down the metric table of capacity. What does (1) a litre, (2) a hectol. = in English measure?

(*a*) A merchant mixes 46 lit. 60 centil. of wine, which cost 1 fr. 55 c. a litre, with 3 lit. 40 centil. of wine, which cost 2 fr. 50 c. a lit.; he retails the mixture at 1 fr. 75 c. a litre. Find his gain or loss.

(*b*) A speculator bought 264 hectares 6 ares of land for 387074 fr. 25 c.; he sold $\frac{8}{9}$ of it at 1465 fr. the hectare; at what price per hectare must he sell the rest, in order to gain 9177 fr. 12 c. by his purchase?

4. (*a*) Extract the sq. root of (1) 9030025, (2) 90300250000, (3) ·000009030025, (4) $32\frac{1}{9}$.

(*b*) Extract the cube root of (1) 3·408862625, (2) $\frac{5}{9}$ to 3 places of decimals.

5. Define (1) a circle, (2) a rectangular parallelopiped, (3) a cube.

What is (1) the circumference, (2) the area of any circle equal to in terms of its radius?

(*a*) A rectangular piece of ground is 32 m. 7 decim. long, and 19 m. 5 centim. broad. Find the cost of enclosing it with a path 1 m. 5 decim. broad, at 3 fr. 5 c. a sq. m. (1) When the path is outside the piece of ground. (2) When the path is part of the ground.

(*b*) A cellar, whose length = 1¼ its breadth, and whose floor is 500 sq. ft., contains 157 cub. yds. 11 cub. ft. Find (1) the depth of the cellar, (2) the area of each of its sides.

(*c*) Find (1) the circumference, and (2) the area of a circular flower bed whose radius is 5 ft.

LXXVII.

1. Define (1) a cube, (2) a right cylinder. How is solid content measured arithmetically?

(*a*) The base of one triangle is 5 m., and its altitude 3 m. The area of another triangle is double the area of the 1st triangle, and its base 4 m. Find its altitude.

(*b*) Find (1) the diameter, (2) the area of a circular bed, whose circumference = 12 m.

(*c*) The surface of the 4 walls of a room, which requires paper, is 96 sq. m.; what will it cost to paper it with pieces of paper, each 5 decim. broad, and 8 m. long, at 3 fr. 75 c. a piece?

2. (*a*) The surface of a cube contains 11094 sq. in.; (1) how many cubic ft. does the cube contain? (2) Shew that the diagonal of the cube = its edge × $\sqrt{3}$.

(*b*) What is the inside surface of a cylinder, the radius of whose base is 18 ft. 3 in., and whose height is 1 yd. 2 ft.?

(*c*) Find the radius of a circle, whose surface is equivalent to the surface of a square, each side of which is 3 m. in length.

3. (*a*) If 3 kilog. of tea be worth 5 kilog. of cocoa, and 7 kilog. of cocoa be worth 11 kilog. of coffee, what will 5 kilog. of tea be worth, if 1 kilog. of coffee is worth 6 fr. 30 c.?

(*b*) A circular plot of $\frac{1}{3}$ ac. has a walk all round it, on the inside, 2 yds. broad; the space within the walk is formed into a croquet ground. Find its size.

4. What is meant (1) by the diagonal of a parallelogram, (2) by the hypothenuse of a right-angled triangle?

(*a*) Extract the sq. root of (1) 3488784401, (2) $17\frac{3}{8}$, each to 3 places of decimals, and the cube root of (3) 529475129, (4) 5 to 3 places of decimals.

(*b*) A park in the form of a rectangle, whose length = $1\frac{1}{3}$ of its breadth, contains 24 ac. 3 ro. $6\frac{114}{121}$ po. If two men start from the same corner, and walk at the rate of $4\frac{1}{3}$ miles an hour, one going round the park, and the other going along the diagonal, how much sooner will the latter reach the opposite corner than the former?

5. (*a*) A cistern, open at the top, is 27 ft. long, 22 ft. wide, and 6 ft. 6 in. deep: find the expense of painting it inside and outside at $1\frac{1}{3}$*d.* per sq. yd., neglecting the thickness of the sides.

(*b*) A rectangular field, 250 yds. long, and 130 yds. broad, is separated into 4 equal parts by 2 bands of trees, 24 ft. wide, parallel to the sides. Find (1) the size of each part, (2) the space covered by the trees.

PAPERS (LXXVIII—LXXXI) ON RULE OF THREE, SINGLE AND DOUBLE, INTEREST, PRESENT WORTH AND DISCOUNT.

LXXVIII.

1. Define Ratio. How is the ratio of one number to another written? What are the terms of a ratio called?

(*a*) If the ratio of *a* to *c* be as 2*s*. is to 5*s*., and the ratio of *c* to *b* as 7*s*. 6*d*. to 11*s*., find the ratio of *a* : *b*.

(*b*) If the consequent be 3 ac., and the value of the ratio $\frac{31}{160}$; what is the antecedent?

2. What is the object of the Rule of Three? Which quantity do you place in the 3rd term? How do you determine which quantity to place in the 1st term?

Work, (1) by the Rule of Three, (2) by an independent method, each of the following examples:

(*a*) If wheat be 6*s*. a bus., what will 7 lds. 4 qrs. 3 bus. cost?

(*b*) Two numbers are to each other as 15 to 17½; the less number is 54·042; find the greater number. 63,049

(*c*) 27 men can perform a piece of work in 15 days; how many men must be added to the number, that the work may be finished in three-fifths of the time? 18

(*d*) If 17 men can be boarded for 1 wk. for 656 fr. 88 c., what will it cost to board 7 men and 6 women for 1 mo., the cost of the board of each woman being two-thirds of the cost of the board of each man? 1700, 16

3. Define Interest. What is the difference between Simple and Compound Interest?

(*a*) Find the simple interest and amount of

(1) £189. 16*s*. 6*d*. for 3⅓ yrs., also for 341 days, at 8¼ per cent. per annum.

(2) $3689. 45 cents at 7 per cent. for 4 yrs. 7 mo.

(*b*) (1) What sum of money, put out at 10 per cent., will produce £12. 10*s*. for interest in 10 days?

(2) At what rate per cent. will £7864. 12*s*. 6*d*. amount, in 5 yrs., to £9175. 7*s*. 11*d*.? 3 1/3

4. What is meant by (1) Insurance, (2) Premium of Insurance, (3) Policy of Insurance?

(*a*) What premium must be paid for insuring goods to the amount of £860 at ½ per cent.?

(*b*) A man, who has a house worth £1000, insures it, at three-fifths of its value, at 3*s.* 3*d.* per cent. What does his yearly premium amount to?

5. Define Present Worth and Discount.

(*a*) Find the present worth of £259. 7*s.*, due 4 yrs. hence, at 3½ per cent. simple interest.

(*b*) A man buys a cottage for 2964 fr. 12 c., and sells it for 3665 fr. 20 c. payable at the end of 1½ yr. How much will he really gain in ready money, if discount be reckoned at 8 per cent. per annum?

LXXIX.

1. Define Proportion. How is a proportion expressed? What is meant by a mean proportional between two numbers?

(*a*) (1) Find a mean proportional between ·0002 and 18.

(2) The 1st, 3rd and 4th terms of a proportion are 3 cwt. 14 lbs., £1. 7*s.* 1*d.*, and £5. 1*s.* 10*d.* respectively. Find the 2nd term.

(*b*) (1) If 23 men can move 346 sacks of wheat in the time that 17 other men can move 306 sacks, which are the better set of men?

(2) If I must hire 2 men and 3 boys for 6 days to do the same piece of work as 11 men and 5 boys could do in 1½ day, compare the work of a boy with that of a man. $2\frac{1}{3}$

2. Apply (1) the single, or double Rule of Three, (2) some independent method to the solution of each of the foll^{g}. Ex^{s}.:

(*a*) A rectangular piece of ground being 25 m. long and 9 m. 69 centim. broad; find the length of another similar piece of ground of the same area, whose breadth is 1 m. 9 decim.

(*b*) A farmer sold 5 loads of barley, each containing 34 bus. 2½ pks., for £40. 7*s.* 11*d.* How much ought 100 qrs. of the same barley to be worth? 18 1 13 4

(*c*) If 24 lbs. of wool make 115 yds. of cloth, 1 yd. wide, how much cloth, 1¼ yd. wide, ought 12 oz. to make? $2\frac{2}{8}$ yds

(*d*) If the wages of 13 men, for 7¼ days, amount to £13. 7*s.* 0½*d.*, how many men ought to work for 4 weeks for £173. 8*s.*?

51

3. (*a*) *A* borrows £612. 10*s*. for 3 yrs. at $3\frac{1}{2}$ per cent. simp. int., and immediately lends it on the same terms at comp. int. How much more will he receive for int. than he will have to pay?

(*b*) A house, which cost £1500, lets for £65 a year; the outgoings for insurance, &c. amount to $1\frac{1}{4}$ per cent. on its cost. What rate of interest does it pay?

(*c*) What number of francs, put out at $4\frac{1}{2}$ per cent. int. for $3\frac{2}{3}$ mo., will amount to 4866 francs?

4. Find the simp. int. on £325. 8*s*. 4*d*. for 3 mo. at 4 per cent. per annum, and the real discount on £328. 13*s*. 5*d*., due 3 mo. hence, at 4 per cent. per annum. Why are these two sums identical?

5. (*a*) My agent, collecting rents at a commission of $4\frac{5}{8}$ per cent., paid me, after deducting his commission, £1482. 3*s*. 9*d*. What amount of rents did he collect?

(*b*) A house and land were sold for £8963, and the owner received £8626. 17*s*. 9*d*. as the net proceeds. What was the rate of commission?

LXXX.

1. Define (1) Abstract Numbers, (2) Concrete Numbers.

Why must the 1st term in a proportion be of the same kind as the 2nd? Why may concrete numbers of the same or different kinds be multiplied together in a proportion?

(*a*) Two market women buy a certain number of eggs at 21 for 1*s*., and the same number at 19 for 1*s*. The 1st sells all her eggs at 18 for 1*s*., and the 2nd sells all hers at 9*d*. a dozen. Compare their rates of profit.

(*b*) If a certain field will graze 2 oxen and 3 horses for 21 days, or 3 oxen and 2 horses for $19\frac{30}{31}$ days, compare the appetite of an ox and a horse.

2. Work by the Rule of Three each Ex. in Quest^{ns}. 2 and 3.

(*a*) 6 men and 5 boys can do a piece of work in 7 days; they work at it, till they have completed $\frac{3}{4}$ of it; then 2 of the men leave and 2 more boys come; how long will the work be in hand, if a boy does half as much work as a man?

(*b*) An innkeeper uses a quart measure, which is too small by ·375 of a pint; of how much will he cheat his customers in selling a butt of beer, if he charges $2\frac{1}{2}$*d*. for a pint?

(*c*) Two old men, *A* and *B*, who are at the opposite extremities of the same diameter of a circular bowling green, which is 1 fur. 8 po. 44 yds. round, start off at the same instant to walk round it, in the same direction, at the following average rates, *A* goes at the rate of $1\frac{1}{8}$ mi. an hr., and *B* at the rate of $1\frac{7}{44}$ mi. an hr. How long will the chase occupy him? How many times will *B* go round the green before he overtakes *A*?

3. (*a*) The rateable value of a person's property is fixed at $\frac{3}{5}$ of its gross value, which is 2000 guineas. What will be his net income, after paying two poor rates of $8\frac{3}{4}$*d.* and 1*s.* 1*d.* in the £ respectively, a highway rate of $4\frac{1}{4}$*d.* in the £, and an income-tax of $2\frac{13}{18}$ per cent. on his gross income?

(*b*) If $\cdot\dot{4}2857\dot{1}$ of a barrel of beer be worth ·72 of £2. 10*s.*, what is the value of ·625 of the remainder?

(*c*) If 10 men or 15 boys can reap a field of 40 ac. in 7 days, working 13 hrs. a day, how many boys must be employed to assist 4 men, so that 8 ac. of the same kind of land may be reaped in $2\frac{1}{2}$ days of 14 hrs. each?

4. (*a*) A person bought a property on the 3rd of March for £1526. 10*s.* and agreed to pay for it, with interest on the purchase money at $4\frac{3}{8}$ per cent., on the 1st of October. What sum will he have to pay?

(*b*) A person owes another 1200 francs; he pays 100 francs at the end of each month. What amount of interest will he have to pay at the end of the year, reckoning money worth 6 per cent.?

5. Explain what is meant by Days of Grace.

(*a*) Find the discount on a £100 bill, due 2 months hence, interest being reckoned at 6 per cent. per annum.

If the discount were £1, what would be the rate of interest?

(*b*) Find the present worth of £409. 10*s.*, due two years hence, at compound interest, the rate of interest being 4 per cent. during one year, and 5 per cent. during the second year.

(*c*) What sum would you receive for a note of £500, due 13 Nov., and discounted on the 1st of Oct., at 7 per cent.?

LXXXI.

1. (*a*) The sum of two numbers is $9\frac{5}{8}$, and their difference is $4\frac{3}{8}$. Find the ratio of the numbers.

(*b*) Work (1) by Rule of Three, (2) by an independent method, each of Ex. (1) and (2), and also the Ex^s. in 2.

(1) If ⅜yd. of ribbon cost 3½*d*., what will be the cost of 6⅓ pieces, each containing 185½ ells?

(2) If a man can walk a certain distance in 32·5 days, walking 11·97 hrs. a day, how long ought it to take him to walk half that distance, walking 11·4 hrs. a day?

2. (*a*) A market woman bought a certain number of eggs at the rate of 4 for 3*d*., and sold them at the rate of 5 for 4*d*., by which she made a profit of 2*s*. How many eggs did she buy?

(*b*) A person, after paying an income-tax on his gross income at the rate of 1⅞ per cent. has a net income of £5924. 5*s*. 11¾*d*. Find his gross income, and also the rate of the tax in the £.

(*c*) If a certain quantity of provisions will serve 1800 men, for 12 weeks, at the rate of 15 oz. a day for each man, how many men would three-fourths of the same stock of provisions maintain for 20 wks. at the rate of 8 oz. a day, for each man?

3. Does it make any difference in the amount of simple interest paid on a given sum of money, if the interest be paid quarterly instead of yearly? Does the same hold good in compound interest?

(*a*) If I lend a friend £1250 at 4 per cent. simple int., and tell him to keep it, until principal and interest amount to £1666. 13*s*. 4*d*., how long will he have it?

(*b*) 5 per cent. on a given sum gives £64. 13*s*. 4*d*. Find 5¼ and 4¾ per cent. of the same sum.

4. Distinguish clearly between Interest and Discount. What is mercantile discount?

(*a*) If the present worth of £838, due at the end of 19 months, be £800, find the rate per cent.

(*b*) What would a banker gain by discounting, at 5½ per cent. on Jan. 1st 1867, a bill for £1000 due on the 1st of May, 1867?

5. (*a*) A person leaves £12670 to be divided among his 5 children and 3 brothers, so that, after the legacy duty has been paid, each child's share shall be twice as great as each brother's share. The duty on a child's share is 1 per cent., and on a brother's 3 per cent. Find what amounts they respectively receive.

(*b*) A person paid £55, at the rate of 5½ per cent., for the insurance of some goods which were lost: he cleared the value of his goods, the premium of insurance, and £45. What was the value of his goods?

PAPERS (LXXXII—LXXXVII) ON PROFIT AND LOSS, STOCKS, EXCHANGE, &c.

LXXXII.

1. (*a*) What is meant by per cent.? Express fractionally in its lowest terms, and also decimally, (1) 2 per cent., (2) ¾ per cent., (3) 5 per cent., (4) 9 per cent., (5) 12½ per cent., (6) 125 per cent.

(*b*) A man, having 750 sheep, sold 8 per cent. of them to *A*, 90 of them to *B*, and 3⅓ per cent. of the remainder to *C*. How many sheep had he still?

2. (*a*) A person bought a barrel of beer at £3. 3*s*., and retailed it at 3¼*d*. a pint; was there a gain or loss? How much per cent.?

(*b*) In 1850 the population of the city of London was 129181; in 1861 it was 113387. Find its decrease per cent.

3. What is Stock? When is the value of stock said to be at par? When at a premium? What is brokerage?

(*a*) What will be the cost of £1500 3 per cent. consols at 89⅜, brokerage being ⅛ per cent.? What rate of interest will such investment obtain?

(*b*) What will 56 Great Eastern shares (£100 each) fetch at 71⅝ per cent. discount, the brokerage being ⅛ per cent.?

(*c*) If £100 stock of a railway be at 62½, and two half-yearly dividends be paid, one of £2. 10*s*., and the other of £1. 13*s*. 4*d*. per cent., what yearly interest will a man, who buys 20 shares at this price, receive, after paying an income-tax of 4*d*. in the £, and what rate per cent. of interest?

4. (*a*) A legacy of £2979. 12*s*. 6*d*. was left to 4 heirs, in the proportion of $\frac{1}{6}$, $\frac{2}{5}$, $\frac{4}{9}$ and $\frac{1}{3}$ respectively. Find the share of each.

(*b*) Three cowkeepers hire a pasture for £35. 7*s*. 6*d*. for 26 weeks: during the time, *A* puts 7 cows in it for 13 weeks, *B* 14 cows for 9 weeks, and *C* 3 cows for 22 weeks. How should they divide the rent?

5. (*a*) A speculator sells at a profit of 50 per cent.; but his purchaser fails, and only pays 10*s*. in the £. How much per cent. does the speculator gain or lose by his venture?

(*b*) Divide 16*s*. 11*d*. among *A*, *B* and *C*, so that ½ of *A*'s money shall equal ⅔ of *B*'s, or ¾ of *C*'s.

(*c*) The sales of a bookseller amount to £25000; one-fourth of the sales are made at a profit of 25 per cent., seven-tenths at a profit of 16⅔ per cent., and the remainder at a loss of 25 per cent. Find the cost of the stock sold?

X

LXXXIII.

1. What is meant by the average of a set of numbers?

(*a*) At a competitive examination there were 7 candidates of the age of 19, 12 at 18, 4 at 22, 9 at 20, and 15 at 17. Find the average age.

(*b*) Find the mean of the following observations of temperature:

$51{\cdot}26\frac{1}{2}^{0}$, 39^{0}, $-2{\cdot}14^{0}$, $74{\cdot}28^{0}$, $63{\cdot}8^{0}$, and $-17{\cdot}12^{0}$.

2. (*a*) What per cent. is (1) 14*s*. of £20? (2) $\frac{3}{10}$ of a gallon of $\frac{5}{12}$ of a barrel?

(*b*) A grocer bought a cask of sugar, containing 2½ cwt. at 4½*d*. a lb.; allowing 2½ per cent. for waste, what must he sell it at per lb., in order to gain not less that 25 per cent.?

(*c*) By selling a house for £994. 10*s*. I gain 17 per cent. on the cost price: what should I have received for it had I lost 17 per cent.?

3. What is meant by the Funds?

(*a*) A person invested £6940 in the 3 per cent. consols at 86⅝, and sold out when they had risen 3½ per cent.; what was his gain, the brokerage on each transaction being ⅛ per cent.?

(*b*) A person, holding 75 of South Eastern Railway shares, (£100 each) which pay an annual dividend of £2. 17*s*. 6*d*., sells out when they are at 69¾, and invests in the India 5 per cents. at 104⅛. Find the alteration in his income, income-tax being 4*d*. in the £, and brokerage ⅛ per cent.

(*c*) Which is the better investment, India stock at 212, paying 10½ per cent., or consols at 90, paying 3 per cent.? How much per cent. better?

4. What is the difference between Simple and Compound Fellowship?

(*a*) *A*, *B*, and *C* are partners in a business; the profits are £825. 16*s*. 6*d*., and they are to be divided thus: *A* is to take £6 for every £4. 10*s*. which *B* takes, and for every £3. 3*s*. that *C* takes. How should they divide?

(*b*) *A* commenced business on the 1st of Jan. 1865 with a capital of £300; on the 1st of May he took *B* into partnership with a capital of £700; at the end of the year they had gained £281. How should they divide it?

5. (*a*) If £1 be worth 6 thalers 20 silver groschen, and also be worth 25 fr. 5 c., find the value of 27 thalers in francs.
Note. 1 thaler = 30 silver groschen.

(*b*) If 5 silver roubles be worth 15*s*. 7½*d*., and £4 be worth 5 Napoleons, and 1 Napoleon be worth 4 dollars 25 cents, find the value of 37 silver roubles in dollars and cents.

LXXXIV.

1. (*a*) A goldsmith melts 17 oz. of gold 22 carats fine, 1 lb. 20½ carats fine, 7 oz. 19 carats fine, and 14 oz. 18¾ carats fine. What is the fineness of the mixture?

(*b*) If 1 barrel of porter at 1*s*. 8½*d*. a gal. be mixed with a hhd. of beer at £1. 15*s*. 3*d*. a barrel, what must be the average price per pint, so that the gain may be not less than 20 per cent.?

(*c*) The average amount, given to 16 people out of a charity, was 3*s*. 2*d*.; 9 of them received 3*s*. 11*d*. each, 4 others 1*s*. 11*d*. each. What average amount did each of the rest receive?

2. (*a*) Out of a pipe of wine, 33 gallons are drawn. What is the amount per cent.? What amount per cent. is left?

(*b*) A merchant buys 180 qrs. of wheat at 6*s*. 3*d*. a bus.; 45 per cent. of it is damaged, and he is obliged to sell it at a loss of 6 per cent.; the rest he sells at a profit of 25 per cent. What does he gain?

3. Why is it that the Funds rise and fall?

(*a*) What sum of money must be invested in the 3 per cents. at 87⅝ to produce an annual income of £250?

(*b*) A person has £5000 to invest; he places two-fifths of it in Great Northern railway £100 shares at 128, which pays a dividend of 6 per cent., five-sixths of the remainder in India stock at 212, which pays £10. 10*s*. per cent., and the rest in 3 per cent. consols at 89. What is his total income? Which is the best stock to invest in, as far as interest is concerned?

4. (*a*) *A* and *B* received for digging a garden 5*s.*; they worked together at it for 4½ hrs., *B* then left, and *A* finished it in 3 more hrs. How ought they to divide the money?

(*b*) £25842 is invested in a brewery; *A* and *B* contribute £5000 and £8000 respectively, and *C* the rest. *A* is to have 15 per cent. of the net profits for managing the business, and *B* and *C* are each to have 20 guineas allowed for attendance on certain days. The profits amount to £7650. How should they be divided?

5. What is meant by Exchange? Rate of Exchange? Par of Exchange?

(*a*) When the rate of exchange between America and France is 5·16 fr. the dollar, between England and Spain £1=4½ piastres, and between France and Spain 3¾ piastres =20·5 fr.; how many dollars should be given for £20. 10*s.*?

(*b*) The par of exchange between England and America being £1=$4·44$\frac{4}{9}$, a merchant in New York wishes to remit to London $67894 25 cents. What will be the amount of his bill in English money, the exchange being at a prem. of 9 per cent.?

LXXXV.

1. (*a*) During the 7 days of a week, at a given hour, the thermometer stood at 64·8°, 66·1°, 64·6°, 67·9°, 66·7°, 64° and 70·8°. Find the mean temperature during the week at that hour.

(*b*) A grocer sold 9 lbs. of tea, 12 lbs. of coffee, and 18 lbs. of sugar, at the average price of 1*s.* 11⅓*d.* a lb.; he had given for the tea 3*s.* 6*d.* a lb., for the coffee 2*s.* 3*d.* a lb., for the sugar 6¼*d.* a lb. What did he gain, and how much per cent.?

2. What is meant by (1) Commission, (2) Insurance, (3) Life Assurance?

(*a*) I employed a butcher to buy some oats for me: he charged 1¼ per cent. commission. The bill he sent to me amounted to £25. 6*s.* 3*d.*, the price of the oats being £1. 6*s.* 8*d.* a qr. How many qrs. did he buy for me?

(*b*) *A* sells to *B* a horse, which had cost him £30, at 12½ per cent. profit; *B* sold it to *C* at a profit of 5 per cent. on what it cost him. What would *A* have gained per cent., had he sold the horse to *C* for the money which *C* paid *B* for it?

3. (*a*) Is it better to invest in the 3 per cents. at 89½, or in mining shares at £233 each, on which a yearly dividend of

£7. 13*s*. 4*d*. is paid? If you have £2000 in the 3 per cents., and exchange it into the other security, what difference will it make in your income?

(*b*) If the 3 per cent. consols be at 90⅛, what sum must I invest in order to secure from them a yearly income of £466, after paying an income-tax of 7*d*. in the £, brokerage being ⅛ per cent.?

(*c*) If I were to sell out half of the amount of the above-mentioned stock when the funds have risen 2½ per cent., and the rest when they have fallen 1¾ per cent., what shall I gain, reckoning brokerage on each transaction at ⅛ per cent.?

4. What is meant by Equation of Payments? In stating the Rule for working sums in it, what assumption is made?

(*a*) If I owe Mr Stafford £2 to be paid in 6 mo., £3 to be paid in 8 mo., and £1 to be paid in 12 mo., find the equated time of payment.

(*b*) *A* owes *B* £1000 at the expiration of 4½ mo., however he pays one-third of it at the end of 3 mo., and one-fourth of it a month later; when ought he to settle the account?

5. (*a*) A father left his property among his four sons, *A*, *B*, *C* and *D*, thus: *A* was to have £6 for every £5 which *B* had, and *C* was to have £3 for every £4 which *A* had, and *D* was to have £8 for every £9 which *B* had. *D*'s share was £1000. What did the father die worth?

(*b*) If 3 men can do as much work in a given time as 5 women, and 3 women as much work as 5 children, divide among 6 men, 11 women and 5 children a week's wages, amounting altogether to £11. 9*s*. 6*d*.

(*c*) The exchange between London and Frankfort is 11 florins 52 kreutzers for £1 sterling, and between Paris and Frankfort 20 francs for 9 florins 20 kreutzers. What is the value of £24. 10*s*. in francs and centimes? 1 flor. = 60 kreut.

LXXXVI.

1. (*a*) In a school of 370 children, 10 pay 6*d*. a week, 80 pay 4*d*., 104 pay 3*d*., 75 pay 2*d*., 81 pay 1½*d*.; the rest are admitted free. What is the average sum paid by each child per week?

(*b*) From Monday to Friday, both inclusive, a man walked daily, on the average, 25 kilom. 24 m.; on Monday he walked 27 kilom. 25 m., and on Saturday 8 kilom. 2 hectom.

45 m. Find his daily average amount of walking from Tuesday to Saturday, both inclusive, in Eng. measure. (1m.=39·3708in.)

2. (*a*) 10 dozen of eggs are bought at 1*s*. 3*d*. a dozen; one-half of them are sold at 1*s*. 5*d*. a dozen, the rest at 2*s*. a dozen. What per cent. is gained?

(*b*) A grocer had 150 lbs. of tea, of which he sold 30 lbs. at 3*s*. 7*d*. per lb., and found that he was only gaining 7½ per cent. At what price must he sell the remainder, so as to gain 10 per cent. on his whole outlay?

(*c*) If 2 tons 2 qrs. be sold for £88. 1*s*. 9*d*., what is the rate of purchase per cwt., the profit having been 45 per cent.?

3. (*a*) A man has £1900 of a 4 per cent. stock, which he sells out at 104, and applies £962. 13*s*. 4*d*. of the proceeds to the purchase of 3 per cents. at 95. The remainder he lends on mortgage. What rate of interest must he get for the mortgage, in order that his income may remain unaltered?

(*b*) If £1100 be invested in the India 5 per cents. at 105⅜, what is the lowest price at which the stock must be sold, so as to produce a gain of at least £200, brokerage ⅛ per cent.?

4. (*a*) Divide 667 fr. 50 c. between *A*, *B* and *C*, so that $\frac{3}{4}$ of *A*'s shall $=\frac{3}{5}$ of *B*'s, and $\frac{2}{3}$ of *B*'s share $=\frac{4}{7}$ of *C*'s share.

(*b*) *A* began business with £1000; 4 months afterwards *B* joined him with a certain sum of money: at the end of 12 months from the time when *A* commenced, their profits were £3000, of which £1800 came to *B*. What sum did *B* invest?

5. What is the par of Exchange between England and France, between England and America? What is a Bill of Exchange? What is the use of such bills in mercantile transactions?

(*a*) At a certain game *A* can give *B* 3 out of 20, *B* can give *C* 10 out of 50. How many can *A* give *C* out of 100?

(*b*) If 10 florins 8 kreutzers = £1 sterling, and if a Napoleon = 16*s*. 3*d*., find the value of 3000 francs in florins.

LXXXVII.

1. (*a*) A merchant bought 18½ qrs. of oats at 28*s*. a qr.; some being damaged, he retained it for his own use, and sold the rest at 4*s*. 1*d*. a bus., losing by this sale 12½ per cent. on his outlay. How much was damaged?

(*b*) If I buy a horse for £40, and sell it for £45 at a credit of 8 months, what shall I gain per cent., reckoning money worth 6 per cent. per annum?

2. What is meant by buying at so much per cent. discount? How are purchases in the funds, &c. made?

(*a*) A man bought five-ninths of the shares of an hotel company at 28 per cent. discount: he retained three-fifths of his shares, and sold the rest for £9200, which was 15 per cent. above cost price. What was the whole capital of the company?

(*b*) *A*, *B* and *C* are partners. *A* receives two-fifths of the profits, *B* and *C* dividing the remainder equally. *A*'s income is increased by £220 when the rate of profit rises from 8 to 10 per cent. Find the capital of *B* and *C*.

3. (*a*) A person has stock in the new 3 per cents., which produces him an income of £240 a year. He sells out one-fourth of the stock at 87¼, and invests the proceeds in railway stock, when a £100 share is worth £174½. What dividend per cent. per annum ought the railway to pay on its stock, so that he may increase his income £40 a year by the transaction?

(*b*) A man by selling out of the 3 per cents. at 99, realises £15345, and gains 10 per cent. on his investment by the transaction. (1) At what price did he buy, and (2) what was his income?

4. How do tradesmen reckon their profits and losses? State a rule "for dividing a given quantity into parts which shall have to each other a given ratio."

(*a*) *A*, *B* and *C* commence business; *A* brought £175, *B* £210; they gained £422. 10*s*.; of which *C*'s share was £172. 5*s*. What amount did *C* put into the business? What share of the profits ought *A* and *B* to receive respectively?

(*b*) *A*, *B* and *C* embark money in a distillery; *A*'s money is three-fifths of *B*'s, and *B*'s is half of *C*'s; at the end of 3 mo. *B* takes out half of his money, but at the end of 2 more mo. puts back half of what he had taken out; at the end of 9 mo. *C* takes out one-third of his money. The profits at the end of the year are only £76. 18*s*. How should it be divided?

5. What is meant by Arbitration of Exchanges? What is the difference between simple and compound Arbitration of Exchange?

(*a*) What will be the cost of a bill on London for £864 in New York, Exchange being at 9½ per cent. premium? Par value is £9 = $40.

(*b*) A banker at New York remits \$6000 to Liverpool, thus: first to Paris at 5 fr. 40 c. for \$1; thence to Hamburg at 185 francs for 100 marks; thence to Amsterdam at 35 stivers for 2 marks; thence to Liverpool at 220 stivers for £1. What sterling money will he receive at Liverpool, and what will be his gain over direct exchange at 8½ per cent. premium? *Note.* Par value is £9 = \$40.

PAPERS (LXXXVIII—C). GENERAL PAPERS ON ARITHMETIC.

LXXXVIII.

1. Explain the Arabic system of notation. What do you mean by 'local value'?

The entire population of Nottingham, Peterborough and Derby, at the census of 1861, fell short of one hundred and thirty thousand by four hundred and eighty one. Nottingham contained 7 times as many inhabitants as Peterborough less 7452; and Derby contained 7886 more than 3 times the population of Peterborough. What was the population of each place?

2. A chemist exchanged 2 dozen bottles of laudanum, each containing 6 ℥. 2 ℈., worth 8½*d.* an oz. for 27 lbs. 2 ʒ. 2 ℈. of rhubarb worth 3*s.* 9*d.* a lb. What money should pass to make the bargain a fair one?

3. Why was leap year introduced, and by whom? What further change did Pope Gregory introduce?

If a man, commencing on Jan. 1, 1867, spend 5*s.* 6¼*d.* a day, how much will he save in 5 years, his yearly salary being £120?

4. The fore-wheel of a carriage, which is 7 ft. in circumference, makes 792 more revolutions than the hind-wheel in a journey of 3¼ miles. Find the circumference, and also the diameter of the hind-wheel.

5. Define a Fraction. When is a Fraction in its 'lowest terms'?

Simplify,

(1) $\frac{54423}{260424}$. (2) $4\frac{4}{7}$ of $3\frac{1}{16} - 2\frac{2}{3}$ of $1\frac{5}{16} + \frac{8}{9} - 1\frac{5}{6}$ of $4\frac{4}{7}$ of $\frac{3}{14}$.

(3) $4\frac{4}{7}$ of $3\frac{1}{16} - 2\frac{2}{3}$ of $\left(1\frac{5}{16} + \frac{8}{9} - 1\frac{5}{6}\right)$ of $4\frac{4}{7}$ of $\frac{3}{14}$.

6. *A* and *B* pay 15*s*. 6*d*. for 2 sacks of potatoes, the sacks being worth $\frac{3}{28}$ of the potatoes. *A* pays 8*s*. $10\frac{1}{2}$*d*., and *B* the remainder. They divide the potatoes equally, but *A* takes the sacks. Which owes money to the other, and how much?

7. *A* can do a piece of work in $1\frac{1}{5}$ day, *B* in $1\frac{1}{11}$ day, and *C* in $2\frac{1}{2}$ days. They commence the work together, but *A* leaves after working for $\frac{1}{4}$ of a day; *C* leaves after $\frac{3}{4}$ of the work is completed, *B* stays and finishes it. How long does *B* work?

8. What profit would there be on an edition of 50000 copies of a book, if there be a profit of ·03125*s*. on each copy?

9. Define Ratio and Proportion. How is it, that if three terms of a proportion be given, the fourth may always be found?

If 16·125 yds. of calico, 1·375 yd. wide, cost £2·2, what ought 45 yds., ·875 yd. wide, at the same price per sq. yd. to cost?

10. A man spends every year one-tenth of his income, and invests the rest in annuities at the rate of £90 for every annuity of £3: supposing his income £1000 to begin with, what will it be at the end of 4 years?

11. Define a Cube. If a cubic metre contain 1000 litres, and a metre contain 39·3078 inches, find the number of cubic inches in a litre.

12. A man embarks his capital in four successive ventures. In the first he clears 100 per cent., and in each of the others he loses 20 per cent.; shew that there remains to him a profit of 2·4 per cent. upon his original outlay.

13. A person holding a certain amount of India 5 per cent. stock, sold out three-fifths of it at $105\frac{1}{8}$, and invested the proceeds in the 3 per cent. consols at $89\frac{1}{8}$: he sold out from consols when they had risen $5\frac{1}{4}$ per cent., and repurchased the same amount of India stock as he had sold out at $103\frac{7}{8}$, and he found that after deducting brokerage of $\frac{1}{8}$ per cent. on every purchase and sale of stock, he had gained by the transaction £205. What amount of stock did he hold?

LXXXIX.

1. Distinguish between Numeration and Notation. What system of Notation did the Romans use? Express (1) seven thousand and six, (2) fifty thousand two hundred and nine, in Roman characters.

(3) What number is that, which being divided by 15, the quotient doubled, the product increased by (6 × 144 ÷ 12), the sum will be 100?

2. A bill for 37 lbs. of mutton and 24 lbs. of veal amounted to £2. 2*s.* 10¾*d.*; the veal cost 1¾*d.* more per lb. than the mutton. Find the price of the mutton per lb.

3. (1) $\frac{8}{13}$ of a number exceeds $\frac{5}{6}$ of half the number by 41⅓. Find the number.

(2) A certain sum of money is divided thus: *A* has one-fifth of it, *B* has 24 fr. 75 c. less than *A*; *C* has one-fourth of it, and *D* has 12 fr. 22½ c. more than twice *A*'s share. How much more has *D* than *C*?

4. Define a Decimal. What is meant by the Decimal Point? What advantages do decimals possess over vulgar fractions?

If the 3rd satellite of Jupiter be ·0000885 of the mass of the planet, and ·02947 of the mass of the Earth, find the mass of the Earth in terms of the mass of the planet to 3 places of decimals.

5. If $\left(2\frac{1}{2} \text{ of } \frac{3}{5}\right) \div \left(\frac{5}{8} \text{ of } 3\frac{1}{5}\right)$ of an acre of land be worth 35 guineas, what will 7 times $\left(\dfrac{7\frac{2}{3} - 4\frac{1}{4}}{\frac{1}{2} \text{ of } 3\frac{5}{6}} \times \dfrac{7\frac{2}{3}}{31\frac{8}{9}}\right)$ of $2\frac{1}{2}$ ac. be worth at the same rate?

6. 270 sheep and 14 horses eat 101 acres of grass in 30 days, and 155 sheep and 21 horses eat 185 acres of grass in 75 days. Compare the amount eaten by a sheep and by a horse in the same time.

7. What is the difference between Simple and Compound Interest?

(1) £150 placed at a Savings Bank amounts in 4 years to £165; what is the rate per cent. per annum simple interest?

(2) The sum of £1600 is left to accumulate for 3 years at 25 per cent., compound interest, and then during four years at 20 per cent.; shew that the resulting sum is £6480.

8. A man invests £153. 14*s.* 4*d.* in the 3½ per cents. at 92, and £184. 12*s.* 6½*d.* in the 2½ per cents. at 85; shew that he

will receive the same income, as he would have received had he invested the whole sum in the 3 per cents. at 90.

9. Explain the reason for 'pointing' in extracting the square root of a number.

The diagonal of a rectangular court yard is 66 yds. 2 ft., and its breadth is 18 yds. 2 ft. Find the length.

10. The inc^e. tax being 4*d.* in the £, a person has to pay £69. 15*s.* 11*d.* less than when the tax was 7*d.* in the £, although his income has increased by £295. What was his income at first?

11. Define 'Exchange,' 'Course of Exchange,' 'Par of Exchange.'

A person visits Hamburg with 34 sovs., 1 half sov., and 6 florins in his purse. He spends there 411 marks 12 schillings. How many florins will he receive in exchange for the remainder, the rate of exchange being 13 marks 8 schillings per £ sterling, and one mark being equivalent to 16 schillings?

12. Define Discount, and from your definition deduce the Rule for finding it.

A bill, due 4 months hence, is discounted at 3 per cent., and its present value is £625. What is the amount of the bill?

13. Two ships are built. Twice as many ship-carpenters are employed about the first as about the second; the first is built in 9 months, the second in 8 months; the wages of each man of the first set are 7*d.* per hour, and they work 12 hours a day; the wages of each of the second set are 6*d.* per hour, and they work 10½ hours a day. The cost of the first ship in carpenters' wages was £6000. What was that of the second?

XC.

1. Shew that a number is divisible by 9, when the sum of its digits is divisible by 9.

Multiply ninety-five millions six thousand and nineteen by 555 in two lines, and prove the correctness of the result by 'casting out the nines.'

2. In the census of 1861 the sum of the populations of Manchester and Birmingham exceeded the sum of the populations of Liverpool and Leeds by 2952, and the sum of the populations of Manchester, Birmingham, and Liverpool exceeded 5 times the population of Leeds by 62168, also the population of Liverpool, which fell short of 5 hundred thousand

by 56062, exceeded the population of Birmingham by 147862. Find the population of each of the four places.

3. A marketwoman purchased some chickens and turkeys for £10. 2*s*. 6*d*. She paid 6⅓ times as much for a turkey as for a chicken. There were 4⅔ times as many chickens as turkeys, and the chickens cost 2*s*. 3*d*. each. Find the number of turkeys.

4. A woman bought eggs at the rate of 8 for 5*d*., and sold them so as to gain 1⅓*d*. on a dozen; (1) What did she charge for each? (2) What did she gain per cent.?

5. Must the terms of a ratio be of the same kind? Why? Write down the metric table of length.

Two rectangular plots of land of the same quality are offered for sale; the 1st, 75 m. long and 15 m. 5 decim. broad for 5400 francs; the 2nd, 60 m. long and 17 m. 25 centim. broad for 5000 francs. Which is the better purchase?

6. The produce of a field of wheat, yielding 4 qrs. per acre, is worth £148, when wheat is at £3 a qr.; what will the produce of the same field be worth, when the yield is 5 qrs. per acre, and wheat is at 50*s*. a qr.?

7. How many different kinds of Vulgar Fractions are there? Name them. Shew that an Improper Fraction is equivalent to a mixed number, and *vice versâ*.

What number is that, from which if you take the sum of $\frac{1}{2}$ of 5 and $\frac{3}{7}$ of $\frac{6}{7}$ of 3⅓, the remainder will be $\frac{1}{5}$?

8. *A*, *B* and *C* buy 340 sheep at £2. 1*s*. 6*d*. each. *A* paid $\frac{7}{15}$ of the money, *B* $\frac{9}{20}$, and *C* the rest. How much did *C* pay?

9. *A* had 50*s*., which was £$\cdot 208\dot{3}$ more than $\frac{2\cdot\dot{6} \text{ of } 5\cdot 25 \text{ of } \cdot 75}{63}$ of *B*'s money. How much money had *B*?

10. Define the terms 'area' and 'solid content;' and shew clearly by diagrams how to find each of them.

A field is surrounded by a belt of trees 18 yards deep, the exterior fence bounding this belt being $50\frac{2}{11}$ rods by $32\frac{10}{11}$ rods; find the expense of mowing the field at 5*s*. 6*d*. per acre.

11. Find to two places of decimals the value of

$$\frac{15+\sqrt{10}}{15-\sqrt{10}}+\frac{30-\sqrt{10}}{15+\sqrt{10}}.$$

12. A bankrupt has book debts equal in amount to his liabilities, but on £3000 of such debts he can only recover 9*s*. 8*d*. in the £, on £1200 only 5*s*. 7*d*. in the £; the expenses of the bankruptcy amount to £1053 15*s*.; he finds that he can pay 10*s*. 9*d*. in the £. Find the amount of his debts.

13. A person invests £6825 in the 3 per cents. at 91; he sells out £5000 stock when they have risen to 98¼, and the remainder when they have fallen to 85. (1) How much does he gain or lose by the transaction? (2) If he invest the produce in 4½ per cent. stock at par, what is the difference in his income?

XCI.

1. State the distinction between Simple and Compound Multiplication.

The population of a town is 1612, the number of women being 94 less than the number of men, and 3 times the number of women being 1637 more than the number of children. Find the number of each class.

2. How many sq. in. are there in 1 ac. 2 ro. 9 po. 2 yds. 2 ft. 19 in.? Reduce the result (1) to sq. chains and (2) to ares, &c., reckoning 1 m. = 39·7 in.

3. If £10500 is 3½ times the purchase money of a farm of 57 ac. 1 ro. 37 po., which is bought £257. 5*s*. 5*d*. below its value, find the value of the land per acre.

4. In adding and subtracting fractions, why is it necessary to reduce them to a common denominator?

(1) Change $2\frac{1}{3}$ of $\frac{13}{14}$ of $1\frac{17}{39}$ into an equivalent fraction having 81 for its denominator.

(2) What number is that, from which if 9 be subtracted, $\frac{4}{19}$ of the remainder is 16?

5. *A* can complete a piece of work in 12 days, working 8 hrs. a day; *B* can complete the same piece of work in 7 days,

working 9 hrs. a day. How long will it take both of them to complete the work if they work together at it 6 hrs. a day?

6. Define the cube root of a number. State the rule for pointing in extracting the cube root of a decimal, and the reason of it.

(1) A rectangular field is 168 yds. 2⅖ ft. long and 126 yds. 1⅘ ft. broad; find (1) the side of a square field of one-third the area, (2) the distance from one of its corners to the opposite corner.

(2) A cube contains 8 cub. ft. 631·457856 cub. in.; shew that there are 2 sq. yds. 6 sq. ft. 104·4576 sq. in. in its surface.

7. What vulgar fractions reduced to decimals produce terminating decimals? Explain the reason.

Find the value of $\cdot\dot{2}\dot{7}$ of $\cdot\dot{1}\dot{1}$ of 2*s*. 9¼*d*., and reduce the result to the decimal of £1, to 4 places of decimals.

8. Define Present Worth and Discount.

Bought a quantity of goods for £47. 9*s*. 8*d*., payable twelve months hence: sold them again for £57. 8*s*. 2*d*., payable ¾ of a year hence; what was the gain in ready money, allowing discount at 4½ per cent.?

9. If 10000 persons, each travelling 30 miles weekly, give a railroad company a receipt of £1200 a week, how many persons, travelling each 25 miles weekly, will bring an income of £130000 a year, the cost of travelling being reduced by one-third?

10. Explain the terms 'Funds,' 'Fundholder,' 'Funds at par.'

If 3½ per cent. consols are at 86⅝, and 4½ per cent. railway stock at £94·50, which is the better investment? What must I invest in consols so as to obtain an income equal to that which I get from £1050 invested in railway stock?

11. What is the area of a circle equal to in terms of its radius?

The circumference of a circular bed is 15 m.; what number of sq. m. will another circular bed contain, whose diameter is 2½ times as great?

12. 1 sov. can be exchanged for 11 gulden 12 kreutzers, or for 25 fr. 50 c., and 1 Napoleon for 9 gulden 20 kreutzers; how much per cent. is gained by buying French gold with English gold before buying German money? *Note.* 1 gul. = 60 kr.

13. In the astronomical clock, the hours are marked upon the dial from 1 up to 24; find the time between 8 and 9 o'clock when the hands are together.

XCII.

1. Define Number. Distinguish between Abstract and Concrete Numbers.

One-fifth of the difference of two numbers = 58, and one-fifth of their sum is less than their difference by 92. Find the numbers.

2. Two persons, starting from the same place and travelling at a uniform speed in opposite directions, are 40 miles apart at the end of 2 hrs., but travelling in the same direction they are 9 miles apart at the end of 1½ hr. How far does each travel per hour?

3. Shew that the value of a fraction will not be altered, if its numerator and denominator be both divided by the same number. How will the value be affected if the same number be added to its numerator and also to its denominator?

Simplify,

(1) $\frac{1}{2}+\frac{2}{3}$ of $\left\{\frac{1}{8}-\frac{3}{4}\text{ of }\left(\frac{20}{21}-\frac{8}{9}\right)\right\}-\frac{2}{7}\div\left(\frac{48}{49}\text{ of }3\frac{1}{2}\right)+\frac{2}{63}$.

(2) $\left(\frac{1}{2}\text{ of }3\frac{4}{17}\text{ of }6\frac{2}{11}-\frac{3\frac{5}{9}}{1\frac{2}{3}}\right)\div\frac{6\frac{7}{8}+5\frac{2}{8}}{9\frac{3}{4}-5\frac{5}{6}}$.

(3) $(184\cdot3\dot{2}\dot{1}+4\cdot532-179\cdot0\dot{6}8\dot{1})\div322\cdot706$.

4. A man gave his 4 children £149. He had 2 sons and 2 daughters, and he gave his daughters twice as much as his sons. At the end of 5 years the sons had increased their shares 30 per cent., and the daughters had spent half theirs. How much had each and all of them at this time?

5. To what class of questions is Practice applicable? Apply the rule to the solution of the following question:

A person, having £20000 to invest, bought 2 farms, one of 118 ac. 20½ po. at £65 an ac., and the other of 95 ac. 3 ro. at 70 guineas an acre, and 25 £100 shares in the South Devon Railway at 55½ per cent. discount. The expenses of these investments amounted to £250. 3*s.* 7½*d.* How much had he still to invest?

6. If 36·75 yds. of cloth, 1·875 yd. wide, be required for a certain number of suits of clothes, how many yds. of cloth, 1⅓ times the width of the former, will be required for 4 times as many suits?

7. A marketwoman bought a certain number of ducks at 2*s*. each, and three-fifths of that number at 3*s*. each; she sold the lot at 5*s*. a pair, and gained by her bargain £4. 10*s*. Find (1) how many of each kind she purchased, (2) her gain per cent.

8. Explain clearly how the area of a rectangular surface is found from its length and breadth.

A quadrangle is 50 ft. long by 40 ft. broad: it is crossed in each direction by a path 10 ft. broad, and the remainder has to be turfed. How many strips of turf, each 1½ ft. long and 6 in. broad, will be required?

9. How is Discount calculated in trade? Which party has the advantage? What is meant by 'Days of Grace'? What is meant by 'Bills payable at Sight'?

A banker discounted on the 3rd of March, 1866, a note for £500 due on the 16th of April, at 7 per cent. (1) What sum did he give for it? (2) What did he gain?

10. A servant is able to put in the Government Savings Bank a sum of £2. 15*s*. the last day of each quarter; calculate her savings after 12 such payments, interest being allowed at the rate of ½*d*. per calendar month for each complete pound.

11. The price of standard silver is 5*s*. 2*d*. per oz., the duty on manufactured silver is 1*s*. 6*d*. per oz. and the cost of workmanship is 1*s*. per oz. If a dozen silver forks are sold for £14. 4*s*. 3½*d*. and the silversmith makes 8⅓ per cent. on the transaction, how many ounces of silver are there in one of the forks?

12. What is meant by 'Par of Exchange,' 'Course of Exchange'? Why does the course of exchange between two countries vary?

A merchant wishes to remit $4000 from New York to London, and the exchange is at a premium of 10 per cent. He finds that he can remit to Paris at 5 fr. 20 c. to the dollar, and to Hamburg at 35 cents per mark banco. The exchange between Paris and London is 25 fr. 60 c. for £1, and between Hamburg and London is 13·5 marks banco for £1: how had he better remit? *Note*, the Par value is £9 = $40.

13. Two trains, 92 feet and 84 feet long respectively, are moving with uniform velocities on parallel rails in opposite directions, and are observed to pass each other in one second and a half; but when they are moving in the same direction, their velocities being the same as before, the faster train is observed to pass the other in six seconds; find the rate in miles per hour at which each train moves.

XCIII.

1. Suppose a man had five hundred and forty-two millions one hundred and six thousand three hundred and four cherries, and that he gave his brother one-fourth of them, each of his three sisters one-eighteenth of them, and his cousin five-twentyfourths of them: what would he make of the remainder, if he sold them at the rate of 12 dozen for 3*d.*?

2. A grocer and draper bought of a wine merchant 13½ doz. of sherry at 33*s.* a doz., and 5½ gal^{s}. of rum at 13*s.* 9*d.* a gal^{n}.; he paid the odd shillings and pence in the bill in money, and the rest of the bill thus: one-sixth of it in sugar at 6½*d.* a lb., five-thirteenths of it in tea at 3*s.* 4*d.* a lb., and the rest, in equal quantities, in flannel at 1*s.* 5¾*d.* a yd., and calico at 10¼*d.* a yd. How much of each of these articles did he give?

3. A pipe of sherry, being eight-ninths full, has 15¾ gallons drawn off. (1) What per centage is this? (2) What part of the pipe is still left?

4. Define the G. C. M. and the L. C. M. of 2 or more numbers.

An island has a road round it 25 miles long; three men, *A*, *B* and *C* start from the same point to travel along this road, round and round; *A* travels 10 mi. an hr., *B* 33⅓ mi. an hr., and *C* 13⅓ mi. an hr. Find the least number of hrs. in which all three will be together again at the point from which they started, and also how many times each will have travelled round the island.

5. A flock of sheep were put into 3 fields; in the 1st field there were 24 less than one-third of the whole number; in the 2nd field half as many again as there were in the 1st field, and in the 3rd field there were 128. How many sheep were there in the flock?

6. State the Rules for the division of decimals.

Simplify

$$\frac{\cdot 12 \text{ of } (\cdot 0104 - \cdot 002) + \cdot 36 \times \cdot 002}{\cdot 12 \times \cdot 12},$$

and express your result as a fraction of ·6.

7. Can the quantities 9 m. 15¾ centim., £3. 7*s*., £1. 11*s*. 6½*d*., 5 m., 18 millim., be formed into a proportion? State the reason.

9 men were engaged to dig a trench, 8 ft. deep, 4½ ft. wide, and 120 yds. long, in a certain time; but before it was begun it was discovered that the trench must be 5 ft. deep, 180 yds. long, but only 4 ft. wide. How many men must be employed, in order that it may be completed in the required time?

8. What is the standard (1) of the gold coin, (2) of the silver coin in England?

If Jewellers' gold be 16 parts pure, and 8 alloy, find the value of 3·08 oz. of jewellers' gold, when 1 lb. of standard gold is coined into £46. 14*s*. 6*d*., the value of the alloy being neglected.

9. State the difference between Simple and Compound Int.

A sum of money amounts in 10 yrs. at 3½ per cent. simple interest to £506. 15*s*. 1½*d*. In how many years will it amount to £703. 16*s*. 6¾*d*.?

10. A man invests £5120 in a stock (*A*), he sells out when the stock has risen 50 per cent. and invests the proceeds in a stock (*B*). He sells out of *B* when its value has fallen 25 per cent., and invests successively in stocks (*C*), (*D*), (*E*), (*F*). He gains by *C*, *E* as he gained by *A*, and loses by *D*, *F* as he lost by *B*; shew that his ultimate gain is £2170.

11. *A* and *B* engage in trade, their capitals being as 7 : 11; at the end of 3 mo. *A* withdraws one-third of his capital, and 1 mo. afterwards *B* adds twice as much as *A* had withdrawn. How should a profit of £337. 7*s*. 6*d*. be divided at the end of the year?

12. The paper duty was 1½*d*. per lb., the duty on playing cards 1*s*. per pack. Three packs of cards weigh 1 lb. The paper manufacturer gains 20 per cent. on his outlay, the maker of the cards 20 per cent. on his sale. The former duty has been abolished, and the latter reduced to 3*d*. Shew that the price of cards might be reduced 1*s*. a pack, allowing each tradesman the same rate of profit as before.

13. A cistern, holding 1200 gallons, is filled by 3 pipes, *A*, *B*, *C* in 24 minutes. The pipe *A* requires 30 minutes more than *C* to fill the cistern, and 10 gallons less run through *C* per minute than through *A* and *B* together. What time would each pipe take to fill the cistern by itself?

XCIV.

1. Define a 'Unit,' 'Product,' 'Dividend.'

The bill for a certain number of lbs. of tea at 3*s.* 6¼*d.* a lb., and 3 times as many lbs. of sugar at 4¾*d.* a lb. amounted to £4. 0*s.* 0½*d.* Find the number of lbs. of each.

Explain clearly each step of the operation.

2. A gentleman bequeathed one-third of his estate to his wife, one-fourth of the remainder to his son, one-fifth of what then remained to his daughter, and he made an hospital his residuary legatee. What did the hospital receive, it being given that the mother's portion exceeded the daughter's by £6066. 13*s.* 4*d.*?

3. Simplify:

(1) $$\frac{\dfrac{2\frac{2}{3}}{3\frac{1}{5}}+\dfrac{2\frac{1}{7}}{7\frac{1}{2}}+\dfrac{2}{7}}{5\frac{8}{15}-4\frac{1}{5}}+4\tfrac{8}{11}\times 2\tfrac{3}{4}+1\tfrac{1}{3}.$$

(2) $$\cdot 01001+5\cdot 27\times\cdot 000483\div\cdot 030.$$

(3) $$\frac{2\cdot 3475 \text{ of } 1 \text{ ton} + 4\cdot 6875 \text{ of } 1 \text{ cwt.} + \cdot 5 \text{ of } 3 \text{ qrs.} - 1\cdot 4 \text{ lb.}}{1\cdot 05 \text{ of } 1 \text{ ton}}.$$

4. When is a fraction said to be in its lowest terms? How are the values of fractions compared?

Reduce $\dfrac{2603616}{16583392}$ to its lowest terms, and find the G.C.M. of ·2603616 and 1658·3392.

5. What is the object of the Rule of Three? Deduce it from the principles of Proportion.

(1) I set my watch at noon on Saturday: at 10.30 A.M. on Monday it had gained 3½ minutes; what will be the real time on Tuesday when my watch is at 3.30 P.M.?

(2) If 24 men can do a piece of work in 1·4 days, working 8·1 hours a day; how many hours a day must 28 boys work in order to complete the same in 4·5 days, the work of a boy being half that of a man?

6. Explain clearly the nature of Compound Interest.

What sum of money put out at 4½ per cent. Compound Interest will amount to £4368. 2*s.* in 2 years? Might this question have been put in any other equivalent form?

7. (1) If an innkeeper retail three-fifths of a barrel of beer for what the whole cost him, what is his gain per cent.?

(2) A man having bought a pig for 23*s.* 4*d.*, wanted to sell it for such a price, that if he reduced that price 12½ per cent. he would still have gained 12½ per cent. on what it cost him. What did he want for the pig?

8. The content of a cubical box is $81\cdot\dot{3}7\dot{0}$ feet; find the cost of lining its inside (lid included) with cloth, $2\cdot1\dot{6}$ feet wide, at 3*d.* a foot.

9. Divide 116 hectar. 5 ares, 80 centiar. among 3 brothers and 7 sisters, so that each brother's share shall be half as much again as a sister's. What is a sister's share equivalent to in English measure, if 1 m. = 39·7 in.?

10. Explain the nature of 'Stock.' (1) If the 3 per cents. are at 89⅝, what should be the price of the 3½ per cents.? (2) If they are at 104, which is the better investment? (3) What dividend will a man receive who invests £3107 in each?

11. My agent in China buys 120 chests of tea, containing 16 lbs. each, at the rate of £2 a chest. The carriage and duty amount to 10 per cent. If I sell two chests which are damaged at a price only 5 per cent. above cost price in China, how much per lb. must I charge for the remainder that I may realize 15 per cent. at least on my whole outlay?

12. A Spanish merchant owes a debt of 5000 dollars in New York; by transmitting the money through France and England, instead of direct, he saves 312 fr. 50 c.; calculate the rate of exchange between Spain and America, the other rates being 5 francs = 4 shillings, 4 reals = 1 franc, 1 dollar = 4*s.* 6*d.*

13. A factor buys a quantity of wheat, which he sells again so as to gain 5 per cent. on his outlay, and thus clears £16. Had he sold it at a gain of 5*s.* a quarter, he would have cleared as many pounds as each quarter cost him shillings. How many quarters did he buy, and what did each quarter cost him?

XCV.

1. Distinguish between Prime and Composite numbers; also between Prime numbers and numbers prime to each other.

I bought seven-eighths of a field, containing $15\frac{1}{2}$ ac., and sold four-fifths of my purchase at £48 an ac.; what did I receive for it? Explain clearly each step of the operation.

2. *A* and *B* inherited from their father the same amount; at the end of 1 year *A* had increased his money one-fifth, and *B* had diminished his by £140. *B*'s money then $=\frac{2}{3}$ of *A*'s money. What did each of them inherit?

3. (1) Simplify:

$$\frac{\frac{3}{5}\text{ of }\left(\frac{6}{7}-\frac{3}{4}\right)}{\frac{7}{9}\text{ of }\left(\frac{3}{4}-\frac{5}{7}\right)}\text{ of }\left\{\frac{\frac{8}{15}-\frac{6}{13}}{\frac{5}{13}-\frac{3}{11}}-\frac{9\frac{1}{5}+3\frac{4}{5}}{5\frac{1}{14}\text{ of }7\frac{1}{9}}+\frac{\frac{7\frac{5}{8}-4\frac{2}{5}}{21}-\frac{19}{21}}{\frac{23}{23}-\frac{19}{21}}\right\}.$$

(2) Express $\cdot 144\dot{2}3076\dot{9}$ as a vulgar fraction, and $\dfrac{\cdot 0759}{2\frac{5}{7}-\frac{23}{24}}\div\dfrac{3\frac{4}{15}-\frac{19}{20}}{14\cdot 75}$ as a decimal.

4. The property of a bankrupt amounts to £4000. It is estimated that the creditors will receive a dividend of 7*s*. 6*d*. in the £: however another liability turns up, which reduces the dividend to 3*s*. 6*d*. in the £. Find the amount of it.

5. Which will it be more advantageous to employ to do a piece of work, 6 men who work 10 hrs. a day for 15*s*., or 9 boys who work 8 hrs. a day for 9*s*., it being given that a man can do half as much work again as a boy in an hr.?

6. (1) Shew that the difference between the interest and discount on the same sum is the interest of the discount.

(2) What is the least number of years for which interest must be reckoned on £145. 7*s*. 6*d*. at 4 per cent., so that the interest may be an exact number of £s?

7. If Railway stock, bought at 28 per cent. premium, pay $7\frac{1}{2}$ per cent. on the investment, what per cent. would it pay, if bought at 10 per cent. discount?

8. A person in Paris wishes to pay a bill in Naples of 2500 ducats: the direct exchange is 4·25 fr. = 1 ducat; the exchange between Paris and London is £1 = 25 fr. 40 c., between London and New York 12 per cent. premium, and between New York and Naples \$1. 40 cents = 1 ducat. What is the difference between the direct and circuitous exchange? Par value is £9 = \$40.

9. A Town-hall and a Church stand exactly opposite each other in a street 26 yds. 2 ft. wide: the height of their towers is 120 and 75 ft. respectively. Find (1) the distance from the top of one tower to the top of the other, (2) the distance from the top of each tower to the base of the opposite building.

10. *A* sold a horse to *B*, who sold it to *C* at a profit of 5 per cent., who sold it for 1071 francs, gaining thereby 20 per cent. What did *B* give for the horse? What gain per cent. was the last price on the first price?

11. Water flows into a rectangular cistern, through a pipe of 12 square inches aperture, at the rate of 2 ft. 4 in. per second, and flows out through an orifice of 7 square inches at 2 ft. 1 in. per second; in what time will three-fourths of the cistern be filled, its dimensions being 15 ft. 5 in. long, 13 ft. 5 in. wide, and 6 ft. 8 in. deep?

12. The receipts of a Railway Company are apportioned in the following manner; 48 per cent. for the working expenses, 10 per cent. for the reserve fund, a guaranteed dividend of 5 per cent. on one-fifth of the capital, and the remainder, £48000, for division amongst the holders of the rest of the stock, being a dividend at the rate of 4 per cent. per annum; find the capital and the receipts.

13. A corn factor having bought 2400 quarters of barley, sold three-fifths of it at a profit of 12½ per cent., one-fourth of it at a profit of 15 per cent., and the rest at cost price; had he sold all the barley at a profit of 10 per cent., he would have realized £47. 5*s*. less. What did the barley cost him?

XCVI.

1. What is 'a Factor,' 'a Power'? How is a power often expressed?

Resolve 8400, 3780 and 8232 into their prime factors, and hence find their G. C. M. and L. C. M.

2. At an election for the chairman of a Board of Guardians 39 votes were given, *C* had 7 votes less than *A*, and 4 more than *B*. How many votes did *A* receive?

3. A labouring man spends $\frac{3}{5}$ of his weekly wages in food, $\frac{1}{10}$ in clothing, $\frac{9}{70}$ in rent, 2*s.* 3*d.* in clubs, and lays by 1*s.* What are his weekly earnings?

4. If $\frac{2}{3}$ of a gallon of Brandy be worth $\frac{7}{8}$ of a gallon of Whiskey, and Whiskey be worth 16*s.* 4*d.* a gallon, how many gallons of Brandy can be bought for £71. 16*s.* 3¾*d.*?

5. *A* is at Leicester and *B* at Glaston (21½ miles apart). *A* leaves for Glaston at 9 A.M., and *B* for Leicester at 9.30 A.M. They meet at 12.8 (noon), and find that *B* has walked ½ mi. an hour more than *A*. How many miles has each travelled?

6. In what sense is a recurring decimal said to be equal to a vulgar fraction? Shew that if a vulgar fraction, when reduced to a decimal, does not produce a finite decimal, it must produce a recurring one. What is the greatest number of figures there can be in the period of a recurring decimal?

Reduce $\left(\frac{2\cdot8 \text{ of } 2\cdot\dot{2}\dot{7}}{1\cdot\dot{3}\dot{6}} + \frac{4\cdot\dot{4} - 2\cdot8\dot{3}}{1\cdot\dot{6} + 2\cdot\dot{6}2\dot{9}} \text{ of } \frac{6\cdot8 \text{ of } 3}{2\cdot25}\right) q.$ to the dec^l. of £1.

7. A bankrupt owes £2157. 9*s.* 2*d.*, and his whole property amounts to £1725. 19*s.* 4*d.*, how much will his creditors receive in the £? One of his creditors would have gained 15 per cent. on his outlay if he had been paid in full; how much per cent. will he lose?

8. What is meant by the expression 'buying at so many years' purchase'?

An estate is bought at 25½ years' purchase for £3400; three-fifths of the purchase-money remains on mortgage at 4½ per cent. The cost of repairs, &c. averages £9. 6*s.* 8*d.* What interest does the purchaser make on his investment?

9. An oblong piece of land, containing 9 ac. 1 ro. 16⅓ po., is one-third as broad as it is long. What is the distance (1) round it, (2) from one corner to the opposite corner?

10. A baker fixes the price of a quartern loaf, when the cost of converting wheat into bread is 5 per cent. on the cost of the wheat, with a view to gaining 20 per cent. on the cost of his bread. Shew that if wheat falls 16 per cent. and the cost of converting it into bread rises 20 per cent., he ought to sell seven loaves for the price at which he before sold six; and that if he does not alter his prices he will gain on his outlay 40 per cent. instead of 20 per cent.

11. A person's income is derived from the proceeds of £3505 at a certain rate per cent., and £5000 at $\frac{3}{4}$ per cent. more than the former rate. His whole income is £420. 4*s*. 6*d*. Determine the rates.

12. The Mint price of gold is £3. 17*s*. 10½*d*. per oz., and the par of exchange between England and France is 25·17 fr. per £1 sterling; what is the weight of the French gold 20 franc piece?

13. (1) A clock which loses 10 sec. per hour is set to the correct time at 9.15 A.M. on Monday. What will be the correct time by the clock when its hour and minute hands point in exactly opposite directions between 9 and 10 o'clock P.M. in the evening?

(2) How must the hands be altered, so that the clock may shew the correct time at noon on Tuesday?

XCVII.

1. If the last figure of a number which is divisible by 4 is itself a multiple of 4, shew that the last but one must be even.

(1) What is the greatest unit of capacity with which 15 kilol. 4 dekal. 4 lit. 3 decil. and 64 kilol. 9 dekal. 8 lit. 7 decil. can both be represented by integers?

(2) The sum of two numbers is 12485 and their greatest common measure is 2497: shew that there are two pairs of numbers satisfying the conditions, and find them.

2. Define a Fraction. Distinguish between vulgar and decimal fractions. Also between proper, improper, compound and complex fractions.

Simplify:

(1) $\dfrac{\frac{1}{2}+1\frac{1}{5}+2\frac{1}{6}}{\frac{1}{2} \text{ of } 1\frac{3}{5}-\frac{1}{3} \text{ of } \frac{4}{5}}$. (2) $\dfrac{5\,\dfrac{1\frac{7}{13}}{4}}{40}$ of 6 hectar. 50 ares.

(3) $\left(\frac{3\frac{1}{3}}{5}+\frac{2\frac{1}{7}}{6}-\frac{1\frac{1}{2}}{9}\right)$ of $\frac{2}{5}-\left(\frac{1\frac{1}{6}}{21}+1\frac{1}{15}-\frac{2}{5}\right)$ of $\frac{1}{3}$.

Express as decimals:

(4) $\frac{1}{25}+\dfrac{\frac{1}{6\frac{2}{3}}}{\frac{1}{\cdot 0\frac{8}{9}}}$. (5) $\frac{35}{57}+\dfrac{\frac{\cdot 00\frac{2}{3}}{7}}{\frac{\cdot 003\frac{1}{3}}{21}}$.

3. Reduce 5 lbs. 10 oz. 3 dwts. 15 grs. troy to the decimal of 1 cwt. avoird.

4. A boy, having received a present from his godfather, gave 5*d.* more than one-sixth of it to his brother, one-third of the remainder less 2*d.* to his sister, 1*s.* more than one-fourth of what then remained to his friend Fanny; after these gifts he had 2*s.* 3*d.* left for himself. How much did he receive from his godfather?

5. Use the Rule of Three, and also an independent method to the solution of

(1) If 5 men can reap a field whose length is 800 feet, and breadth 700 feet, in 3½ days, of 14 hours each, in how many days, of 12 hours each, can 7 men reap a field whose length is 1800 feet, and breadth 960 feet?

(2) A railway company receive weekly £4025. 1*s.* 3*d.* from passenger, and £3176. 2*s.* from goods traffic. The expenses of working are £28804. 13*s.* per calendar month. What interest can they pay per share of £100, their capital being £2000000?

6. The imperial standard bushel contains 2218·192 cubic inches. How is this determined?

Which will contain more wheat, a cubical bin, whose edge is 10 ft., or a bin, whose edges are 12, 10 and 9 ft. respectively? How many more qrs. will the one hold than the other?

7. A man and his wife go to bed every night at 11 o'clock, the man rises at 5.15 A.M., and his wife at 8.30 A.M. What per cent. of each day does the wife spend in bed more than the husband?

8. A broker, whose commission is one-eighth per cent., receives £4064. 14*s.* 7½*d.* to invest in bank stock at 188⅝. What amount of stock can he buy?

9. How far may I ride with a friend, who leaves Glaston at 9 o'clock and will drive to Stamford (10 miles) in 1 hr., so

that I may, by walking back at the rate of 4 miles an hour, reach home at 11.30 o'clock?

10. If in London I get £1 for 25 fr. 20 c., what shall I gain or lose per cent. by taking French money to Bavaria, when the exchange is there 11 gul. 40 kr. for £1, and 9 gul. 20 kr. for a Napoleon? *Note.* 1 gulden = 60 kreutzers.

11. Explain fully the difference between true and mercantile discount.

(1) A debt is paid on 23rd June by a bill dated at 6 months. Supposing the bill to be discounted on October 14th, the real discount would be £3. 10*s*. Find the amount of the bill, the rate of discount being 5 per cent.

(2) The ready-money price of a dress at a tradesman's, who allows mercantile discount in the ordinary way for ready money, is £8. 11*s*., and the credit price is £9. What ought the credit price to be, in order that, while charging the same ready-money price, he may allow twice the rate of discount?

12. A person invests in the 3 per cents. so as to receive 3 per cent. clear on his investment when the income-tax is 9*d*. in the £. What per centage will he receive if the income-tax be increased to 1*s*. in the £?

13. Assuming that the surface of a sphere is 3·14159 times the square on its diameter, and that the earth is a sphere whose diameter is 8000 miles, find what fraction of the earth's surface is occupied by England and Wales, the area of which is 37324915 acres.

14. If, when oats are 15*s*. 9*d*. a qr., and hay £3. 13*s*. 4*d*. a ton, 7 horses can be kept 8 days for £4. 1*s*. 3*d*., how many weeks can 16 horses be kept for £95, when oats are 16*s*. a qr., and hay £3. 10*s*. a ton, supposing that 1 bus. of oats is consumed with 126 lbs. of hay?

15. What will be the expense of painting the walls of a room, length 18·7 ft., width 15·8 ft., and height 10 ft., at 5*d*. per sq. ft., deducting 16 per cent. (from the area) for windows, &c.?

XCVIII.

1. What are the characters of the Roman system? Mention the principles on which they can be combined so as to represent all numbers.

(1) Express the numbers 1864, 7003 according to the Roman system of notation, and write down in words the numbers 600705002; CCIↃↃ; IↃↃↃ; and $\overline{\text{VIII}}$.

(2) Find the product of 1234567 and 4321089, and test the truth of your result by casting out the nines. In what cases does this method of proof fail?

2. *A* and *B* respectively own four-elevenths and two-ninths of a business, worth £355. 11*s*. 6*d*. They exchange their shares. What money ought to pass between them?

3. 8 women were to receive for gathering 500 bus. of raspberries one-sixteenth of the quantity gathered. After 200 bus. had been gathered 3 of the women leave, but the other 5 stay and complete the task. If raspberries be worth 1⅓*d*. a pint, what sum of money would each person earn?

4. Shew that dividing the numerator of a fraction by a number has the same effect on the value of the fraction as multiplying the denominator by that number.

A, *B* and *C* own a farm of 652 ac. 3 ro. 5 po. 9¾ sq. yds. *A* owns $\frac{43}{147}$ of it, *B* $\frac{4}{21}$ of it more than *A*, and *C* the remainder. How much more has *A* than *C* in French measure, taking 1 m. = 39·7 in.?

5. State and explain the rules for converting recurring decimals into their equivalent vulgar fractions, taking $\cdot\dot{6}2\dot{9}$, and $2\cdot411458\dot{3}$ as examples.

(1) Find the value in acres of

$$\cdot75 \text{ of } \frac{1\frac{3}{7}}{1\frac{4}{5}} \text{ of } \frac{8\cdot5}{2\cdot25} \text{ of } \frac{1\cdot\dot{3}}{\cdot0\dot{2}\dot{6}} \text{ of } \frac{\text{£}3.\ 5s.}{14s.\ 3d.} \text{ of } \frac{\text{1 yd. 1 ft. 6 in.}}{\text{6 yds. 2 ft.}}$$

$$\text{of } \frac{\text{1 lb. 6 oz. 17 dwts. 2 grs.}}{\text{2 lbs. 2 oz. (avoird.)}} \text{ of } \frac{\text{77 da. 4 hrs. 30 min.}}{\text{6 da. 12 hrs.}}$$

$$\text{of } \frac{\text{136 gal}^{s}\text{. 2 qts.}}{\text{178 gal}^{s}\text{. 3 qts.}} \text{ of 517 sq. ft. 72 sq. in.}$$

(2) Shew that

$$\frac{1}{2^2}+\frac{2}{2^3}+\frac{3}{2^4}+\frac{4}{2^5}+\frac{5}{2^6}+\frac{6}{2^7}=\cdot9375.$$

6. The West Riding of Yorkshire contains 1708026 acres, and the county of Durham 622476; and at the census of 1861 their populations were 1507511 and 509018 respectively; which is the more thickly peopled, and by how much per cent.?

7. Explain the reason of pointing in extracting the cube root of any number.

Simplify (1) $$\frac{2\times\sqrt{\left(1+\frac{1}{3}\right)}\div\sqrt{\left(1-\frac{1}{5}\right)}}{5\times\sqrt{\left(1+\frac{1}{3}\right)}\times\sqrt{\left(1-\frac{1}{5}\right)}}.$$

(2) $\sqrt[3]{(\cdot 000045499293)}-\sqrt[3]{(\cdot 000000000008)}$.

(3) Which is the greater $\sqrt[3]{9}$ or $\sqrt[4]{19}$?

8. A cask of 150¼ gallons is bought for £75, and kept 12 years, during which three-fourths of a quart evaporates yearly. At what rate per gallon must the contents be sold to clear 20 per cent.; the rate of simp. int. being 4 per cent.?

9. A house cost 3 times as much for materials as for labour. Had the materials cost 7½ per cent. more, and the labour 5 per cent. less, the cost of the house would have been £2087, 10*s*. What was its cost?

10. (1) A person buys 3 lbs. 2 oz. 8 dwts. 16 grs. at 17*s*. 6*d*. per lb. The substance is reduced in price by one-tenth, but he pays the same amount to the seller; how much more does he get?

(2) If 20 men, in 3½ days, can dig 7 rectangular fields, the sides of each of which are 40 and 50 yards respectively, how long will 37 men be in digging 53 fields, the sides of each of which are 90 and 129½ yards respectively?

11. The discount on a sum of money due some time hence is £35, and the simp. int. on the same sum, for the same time, at the same rate of int. is £39. 18*s*. Find the sum. If the time be 4 years, what will be the rate per cent., allowing simp. int.?

12. An oblong plot of ground, 106 yds. 9 in. long, and 55 yds. 2 ft. broad, has a moat dug round it on the outside, 15 yds. wide, and 8 ft. deep. If the earth from the moat were thrown upon the garden in uniform thickness, how much would the surface of the garden be raised?

13. If 25 ac. 1 ro. 37 po. of land be worth £2301. 16*s*. 1½*d*., what will be the worth of 100 ac. of land, half as good again, in dollars, if sterling money be 8½ per cent. above the par value?
Note. Par value is £9 = $40.

14. *A*'s age is to *B*'s as 4 to 3; 18 years ago *A*'s age was double of *B*'s. What are their present ages?

15. If I invest £5592 in the new 3 per cents. at 87½, and if I sell out at the end of 3 months at 90, after having received

one half-year's dividend, what sum including interest shall I have gained? the brokerage being 2*s.* 6*d.* per cent. on the investment as well as on the sale of stock, and the income-tax on the dividend being 4*d.* in the £?

16. An agent agreed to collect a rent-charge, 2½ per cent. being allowed to him on the net receipts. The rates amounted to 4*s.* in the £ on the gross rent-charge, and the income-tax was paid at the rate of 4*d.* in the £ on the remainder. The sum paid to the owner of the rent-charge was £383. 10*s.* Find the gross amount of the rent-charge, and the sum paid to the agent.

XCIX.

1. Shew that a number is divisible by 99, if the sum of the digits in the odd places + 10 times the sum of those in the even is divisible by 99.

The product of the first and second of three numbers is 377, of the second and third, 481, and of the first and third, 1073; find the numbers.

2. Distinguish between Simple and Compound Practice. What is an Aliquot Part? Apply Practice to the solution of the following examples:

(1) A woman bought 17 lbs. of loaf sugar and 25 lbs. of brown sugar, the price per lb. of the latter being seven-ninths of the price per lb. of the former, which was 6¾*d.* per lb. Find the amount of the bill in francs, &c., if a Napoleon = 16*s.* 3*d.*

(2) A man having 2½ butts of beer, wishes to rack it off into bottles, each bottle holding seven-eighths of a litre. How many dozens of bottles must he procure, supposing 7 gallons to be wasted, and 1 lit. = 1·8 pt.?

3. An ignorant fellow said that he should spend half his income, save a third, and devote a fourth to his business. His income was £780 a year. Point out his blunder, and divide his income rightly in the same proportions.

4. A man, walking a distance of 18 miles, finds at the end of 1 hr. 48 min. that the distance which he has walked is five-sevenths of the remaining distance. Find his average pace.

5. How can you find the area of a circle, if you know its circumference?

(1) Find, in acres, &c., the area of a rectangular field, of which the longest side is to the shortest in the ratio of 15 to 8, and which a person, walking at the rate of $3\frac{3}{11}$ miles an hour, takes 5 minutes 45 seconds to walk round.

(2) A man fastens his cow by a rope to a stake in the hedge of an oblong grass field. What must be the length of the rope if the cow be allowed 1 acre to graze upon?

6. Explain the term 'Rate per cent.'

(1) If *A*'s income be 150 per cent. more than *B*'s, how much per cent. is *B*'s income less than *A*'s?

(2) A person, who commenced business $5\frac{3}{4}$ ys. ago, increased his capital at the rate of 15 per cent. per annum, simp. int., and it now amounts to £5960. What sum did he start with?

7. Explain clearly the difference between discount and interest. Deduce the rules for finding each of them from the definitions. How do bankers reckon in discounting bills?

If the discount on a sum due at the end of $2\frac{1}{2}$ yrs. be $\frac{80}{87}$ of the simple interest, at what rate is the interest calculated; and if the discount and interest together amount to £46. 5*s*. $5\frac{1}{2}$*d*., what is the sum of money?

8. Find the diagonal of a box whose edges are $4{\cdot}\dot{2}8571\dot{4}$, $5{\cdot}\dot{7}1428\dot{5}$ and $17{\cdot}\dot{1}4285\dot{7}$ inches respectively, and the cost of gilding it, lid included, at 1*s*. $0\frac{1}{4}$*d*. per 10 sq. inches.

9. *A*'s present age is to *B*'s present age as 8 : 7; 27 years ago their ages were as 5 : 4. Find *B*'s age.

10. Two houses are built; 3 times as many workmen are employed about the 2nd as about the 1st; the 1st is 16 months in building, the 2nd is 12 months; the wages of each man of the 1st set of men are $4\frac{1}{2}$*d*. an hour, and they work $10\frac{1}{2}$ hrs. a day, the wages of each man of the 2nd set of men are $3\frac{3}{4}$*d*. an hour, and they work 12 hrs. a day. The cost of the 2nd house in workmen's wages was £750. What was that of the 1st?

11. A market woman sold out of a basket of eggs to *A* one-third of what she had less 5, to *B* one-fifth of what she then had less 12, and to *C* three-fourths of what she then had less 20; she had still 60 eggs left. How many had she at first?

12. A tradesman imported a quantity of foreign goods for which he had to pay a duty of 15 per cent., but the demand for them having gone off he is obliged to sell at a loss of $5\frac{5}{7}$ per cent.; a month earlier he could have sold them for £124. 4*s.* more, and then would have cleared $2\frac{6}{7}$ per cent. on the transaction; what price did he pay for the goods?

13. A train, 88 yards in length, overtook a person walking along the line at the rate of 4 miles an hour, and passed him in 10 seconds. Twenty minutes after the train overtook another person, and passed him in 9 seconds. When will the last person overtake the first?

14. *A*, *B* and *C* run a race consisting of a certain number of laps round a circular course. The times which they respectively take in running a single lap are $3'\ 36''$, $4'\ 3''$, and $4'\ 30''$. Supposing all three to start together, find how soon *A* and *B* will be together again, and how long the race must be prolonged in order that all three may be again together at the starting post?

15. A boat is rowed down a river at the rate of a mile in 6 minutes, and up the river at the rate of a mile in 10 minutes, the crew working equally hard; find the velocity of the current.

16. Calculate

$$\frac{a}{1}-\frac{a^2}{2}+\frac{a^3}{3}-\frac{a^4}{4}+\frac{a^5}{5}-\frac{a^6}{6}+\frac{a^7}{7}$$

to 10 places of decimals, when $a=0{\cdot}1$.

C.

1. (1) State the tests of divisibility of numbers by 8, 9, and 11; and apply them to the number 370524.

(2) The L.C.M. of two numbers is 3060288, and their G.C.M. is 168. One of the numbers is 12096; find the other.

2. A grocer selling $12\frac{5}{8}$ lbs. of butter, at the rate of 8 lbs. for 10*s.* 8*d.*, gains 4*s.* $8\frac{3}{4}$*d.* $\frac{1}{4}$*q*. Find the cost price of the butter per lb.

3. A man has £3150 in hand, having lost ·6 of his property in a farm, and purchased a house with ·125 of the remainder. What was he worth at first?

4. A person has a sum of money put out at 4½ per cent After paying income-tax at 4*d.* in the £, he finds his income to be £1416 a year. What is his capital?

5. How many cubic inches does (1) the imperial gallon, (2) the imperial bushel contain?

If it cost 15 guineas to make a cubical cistern, open at the top, with lead, at 1*s.* 9*d.* per sq. foot, inside measurement, how many gallons will the cistern hold?

6. A man leaves his property to his wife, two sons, and three daughters, as follows. His wife's share is to be double that of each of the sons, and three times that of each of the daughters; 2½ per cent. has to be deducted to satisfy his creditors. And the share of each daughter is then £1542. 18*s.* 4*d.* What was the value of the property?

7. A bar of metal, one square inch in section, can just sustain a weight of one ton; also a cubic inch of the metal weighs 4 oz. Find the length of the longest wire of uniform section into which a cubic foot of the metal can be drawn, so as not to break when suspended at one end.

8. Define Compound Interest.

Find the compound interest on £100 for 5 years at 5 per cent., and apply your result to find the amount of £8640 in the same time and at the same rate of compound interest.

9. When the 3 per cent. consols are at 89⅝, what must be the price of the India 5 per cents., that it may be advantageous to tranfer from the former into the latter, one-eighth per cent. brokerage being charged both on the sale and purchase of stock?

10. *A*, *B* and *C* enter into partnership; *A* and *B* place their capital in the hands of *C*, who is to have the sole management, but who does not invest any money in the business. It is agreed that when the net annual value profits are not less than 5 per cent. on the capital, *A* and *B* shall receive 4 per cent. on their money, and of the rest *C* shall receive one-half, and the other half shall be divided between *A* and *B* in proportion to their investments. If *A* embark in the concern half as much again as *B*, and *C* receive £250 when the profits are 5 per cent., find the amount invested by *A* and *B*, and the share of each partner when the net profits are £3500.

11. If the estimated annual value of the property in a certain parish consist of the yearly rent paid to the landlord together with the rates, and the rates be calculated upon the rent after a reduction of 30 per cent.; find the rateable value of a tithe-rent charge, the estimated annual value of which is £668 per annum, when the rates amount to 3*s*. in the pound.

12. What ought to be the cash price of an article, the credit price of it being £114. 1*s*. 7*d*., and $4\frac{1}{2}$ per cent. simple interest per annum being allowed?

13. On a certain day mackerel were being sold at a certain price per dozen, on the next day as many fish could be bought for 1*s*. as dozens for £1 the day before. The whole price of 20 fish, 10 bought one day, and 10 the other, was 2*s*. 2*d*. Find the price of a fish on each day.

14. (1) Express $\sqrt[3]{\cdot 00448}$ as a decimal of $\sqrt[3]{\cdot 0875}$.

(2) Prove that $\sqrt[3]{\cdot\dot{0}3\dot{7}} = \cdot\dot{3}$.

15. If 9 oxen are kept for the same money as 7 horses (for any given time), and a team of oxen are one-fifth as long again in ploughing 97 acres as the same number of horses are in ploughing 90 acres; and a field costs as much whether ploughed by oxen or by horses, viz. £7. 5*s*. 6*d*.; the same men being required in both cases, and paid by the time, what is due to them?

16. Having £4000 to dispose of, a man puts one quarter of it in the 3 per cent. stock at $89\frac{3}{8}$, one quarter he puts out at mortgage at $4\frac{1}{2}$ per cent., one quarter he invests in land at £50 an acre, the yearly rent of which is 35*s*. an acre, the rates being 2*s*. 6*d*. in the pound, and the rest he leaves on deposit at a bank, where the rate of interest averages $4\frac{5}{12}$ per cent. What income does he get from all these sources, and what income tax (at 4*d*. in the £) does he pay?

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ANSWERS

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TO

BARNARD SMITH'S

EXAMINATION PAPERS IN ARITHMETIC

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ANSWERS.

I. Page 1.

1. (*a*) 2, 5, 8, 10, 13, 16, 19. (*b*) four, seven, eleven, fifteen, seventeen, twenty.
3. 8, 8, 10, 16, 14. 4. (1) 9; (2) 11; (3) 14; (4) 15; (5) 16.
5. (*a*) 11 oranges. (*b*) 20 oranges. (*c*) 24 eggs.

II. Page 1.

1. (*b*) (1) 14; (2) 18; (3) 21; (4) 20.
2. (*a*) sixteen, twenty-two, thirty-five, forty.
(*b*) 9, 14, 41, 26, 62. 3. (*a*) 18 yrs. (*b*) 20 pence.
4. (*a*) 20 girls, 52 boys and girls. (*b*) 27 pence.
5. 3, 0, 6, 7, 5. 6. 7 yrs., 16 yrs.

III. Page 2.

2. (*a*) 7, 17, 2, 20; 10; 18.
3. (*a*) (1) 30; (2) 31; (3) 22; (4) 30; (5) 4; (6) 6.
(*b*) (1) 1248; (2) 10737; (3) 13915.
(*c*) (1) 12; (2) 93; (3) 197. 4. (*a*) 2 pinks. (*b*) 17*s*.
5. (*a*) Mr Warren had £22 more than Mr Stafford.
(*b*) John has 1*d*., Harry 3*d*., Charlie 4*d*.; Charlie has 3*d*. more than John.

IV. Page 3.

1. (*a*) four, forty, four, four thousand, four hundred thousand.
(*b*) 126, 507, 570, 859, 295. Four hundred and seventeen, five hundred and ninety, six hundred and fifty-nine, eight hundred and eighty-six, nine hundred, six hundred and seven, sixty-seven. 2. (*b*) 995 sheep. 3. (*a*) (1) 6150; (2) 12832; (3) 14843. (*b*) (1) 204; (2) 176; (3) 901.
4. (*a*) 5 cows and 14 bullocks, 9 more bullocks than cows. (*b*) 6. 5. (*a*) 1865. (*b*) 8 more girls than boys.

V. Page 4.

1. Two hundred and seven, two thousand seven hundred, twenty thousand and seven, two millions seven thousand, two hundred millions and seventy; 481, 6090, 300401, 52043016.
2. (*a*) (1) 847444. (2) 5179961. (*b*) (1) 289; (2) 909.

3. (*a*) 12 pigs. (*b*) 2*d*.
4. (*a*) 3, 6, 9, 10, 18. (*b*) IV, VII, XII, XIX, XX.
5. (*a*) 3. (*b*) 879.

VI. Page 5.

1. (*a*) (1) 7; (2) 9; (3) 3; (4) 11. (*b*) 5. 2. (*a*) 379708.
(*b*) 1546937*s*. 3. (*a*) 2339*s*. 4. (*a*) £2914.
(*b*) VIII, XI, XXXVI, L, LXX, CXXVI, 29, 83, 206.
5. 52 yrs.

VII. Page 6.

1. (*a*) Eight hundred and eighty thousand seven hundred and forty-two. (*b*) 10381.
2. (*a*) 3 mi. further. (*b*) *C* is 3 yrs. older than *D*.
3. 79920 units. 4. (*a*) 3654, 15318, 39900, 76000.
5. (*a*) 8*s*. (*b*) 323 yrs., less by 1 yr.

VIII. Page 6.

1. (*a*) £11902. (*b*) 8992. 2. 56, 10.
3. (*a*) *A* has 80, *B* 69, and *C* 157. (*b*) 251 and 389.
4. (*a*) (1) 1824186; (2) 79228058; (3) 946065750. (*b*) 191.
5. (*a*) 4672 panes. (*b*) his gain = £83.

IX. Page 7.

1. (*a*) 19213081. (*b*) 109, CIX, 99, XCIX.
2. 8960436, 89604360000. 3. (*a*) £259787. (*b*) 67*s*.
4. (*a*) 28044. (*b*) 1666 days. 5. 836 gallons.

X. Page 8.

1. (*a*) 16 marbles. (*b*) 1699434.
2. (*a*) 178060. 3. (*a*) 13 times, (*b*) 2305, 7802 remʳ. 506.
4. (*a*) 407100. (*b*) 400 yrs. 5. (*a*) 75 times. (*b*) 700.

XI. Page 9.

1. (*a*) 86576540. (*b*) 80301. 2. (*a*) 53*s*. (*b*) 900 apples.
3. (*a*) 381386096. (*b*) 659*s*. 4. (*a*) 45796. (*b*) 3679.
5. (*a*) £17. (*b*) The son had 495, and the daughter 297, and there were 6 pears over.

XII. Page 10.

1. (*a*) 48, 103, 100003, 101002, 1866.
(*b*) (1) 20000. (2) 141332. (3) 292. 2. (*a*) 9 miles. (*b*) 36 yrs.
3. (*a*) 284. (*b*) The waistcoat cost 9*s*., the jacket 12*s*., and the trousers 15*s*. (*c*) *C* had 1545 more sheep than *B*.
4. (*a*) 203. 5. (*a*) 51 days. (*b*) 1429 nuts.

XIII. Page 11.

1. (*a*) Twenty millions eight hundred and ten thousand nine hundred and seventy-six, one million one hundred thousand three hundred and forty; 300703047; XXXIV, LXXVII, CCCXCVIII, $\overline{\text{V}}$XC. (*b*) 2664. (*c*) 14062 head of cattle.
2. (*a*) 99999. (*b*) 32 days.
3. (*a*) 29 yds. (*b*) Div^{d}.=581506, 581550.
4. (*a*) quot. 8, rem^{r}. 656, 360 rem^{r}. 36. (*b*) 450.
5. (*a*) £20. (*b*) *A* will have 60 eggs, *B* 180, and *C* 360.

XIV. Page 12.

1. (*b*) 72720. 2. (*a*) 532. (*b*) 49505296. 3. (*a*) 1 mile.
(*b*) 38 miles. 4. (*a*) 11 sov. (*b*) 694 yrs.
5. (*a*) 175*d*. (*b*) 865 lbs.
(*c*) The old men receive 50 yds., the old women 130, and the families 60 yds.

XV. Page 13.

1. (*a*) 1428929. (*b*) 987. 2. (*a*) quot.=98 rem^{r}. 21.
(*b*) 406 sheep. 4. (*a*) 12 days, (*b*) 395 and 361.
5. (*a*) 28 parcels of each kind. (*b*) £101.

XVI. Page 13.

1. (*a*) 817947. (*b*) 26973.
2. (*a*) 38 must be added, 32 must be taken from it.
(*b*) 105984 pts. 3. 5 × 7, 2 × 2 × 2 × 3, 2 × 2 × 3 × 7, 2 × 2 × 2 × 2 × 2 × 3, 3 × 5 × 7, 2 × 2 × 109, 2 × 2 × 2 × 5 × 5 × 5.
4. (*a*) 105. (*b*) 480. 5. (*a*) 30 bullocks. (*b*) 108500 rations.

XVII. Page 14.

1. (*a*) Quot.=3, rem^{r}.=70211.
(*b*) Prod.=4575599919.
2. (*a*) 147840 steps, 336 mi., 4032 mi. (*b*) 221760 steps.
3. (*a*) 3902. (*b*) 100 yrs.
4. (*a*) 18*d*. (*b*) 3 men.
5. (*a*) Div^{d}.=2220. (*b*) £56.
6. (*a*) 27=3 × 3 × 3, 56=2 × 2 × 2 × 7, 78=2 × 3 × 13, 144=2 × 2 × 2 × 2 × 3 × 3, 254=2 × 127, 500=2 × 2 × 5 × 5 × 5.
(*b*) *A*'s share=£546, *B*'s £569, *C*'s £1160, *D*'s £1700.
(*c*) 6700 steps.

XVIII. Page 15.

1. (*a*) 54. (*b*) 4750 potatoes.
2. (*a*) 49. (*b*) 21 of each. 3. (*a*) 173 trucks.
(*b*) 53 yrs., The Queen was born in 1819.

4. (*a*) The numbers are 1000 and 600.
5. (*a*) 135 = 3 × 3 × 3 × 5, 126 = 2 × 3 × 3 × 7,
432 = 2 × 2 × 2 × 2 × 3 × 3 × 3, 255 = 3 × 5 × 17, 1207 = 17 × 71.
(*b*) He gained £4 a head, no. of bullocks = 175.
6. (*a*) 315 lbs. (*b*) *A*'s legacy = £600, *B*'s = £528, and *C*'s = £672. (*c*) 7912 mi.

XIX. Page 17.

1. (*a*) No. of white = 8423274, no. of free coloured = 19040306, no. of slaves = 3981509. (*b*) 5832.
2. (*a*) 14 yrs. (*b*) rem. = 993959.
3. (*a*) 403. (*b*) 15 more pigs.
4. (1) 17*s*. 7*d*. = 844*q*. (2) £1. 9*s*. 11¾*d*. = 1439*q*.
(3) 5 guin^{s}. = 5040*q*. (4) £7. 0*s*. 6¼*d*. = 6745 *q*.
5. (*a*) *A* ought to give *C* £385. 5*s*. 9*d*.
(*b*) £2. 7*s*. 4¾*d*.

XX. Page 18.

1. (*a*) 110. (*b*) 734. 2. (*a*) 735 ac.
(*b*) Quot. = 83742 rem^{r}. 710. 3. (*a*) (1) £527. 12*s*. 8½*d*.
(2) 502 guin^{s}. 10*s*. 8½*d*. (*b*) 10107 guin^{s}. 18*s*.; 636795 fourpences. (*c*) 18050 mills. 4. (*a*) £14. 0*s*. 7½*d*.
(*b*) £4. 10*s*. 10½*d*. (*c*) (1) 132 dolls. 77 cents.
(2) 675 dolls. 92 cents. (3) 2414 dolls. 5. (*a*) £670. 8*s*.
(*b*) 216 lambs, £50. 8*s*.

XXI. Page 19.

1. (*a*) £6. 9*s*. 0¼*d*. (*b*) £5. 2. (*a*) £125.
(*b*) 108 dolls. 38 cents. 3. (*a*) 15 men, 35 boys.
(*b*) (1) 5080 rem^{r}. 34. (2) 5 rem^{r}. 8034. 10 rem^{r}. 278570.
4. (*a*) (1) 640 fr. (2) 20005 c. (*b*) 7 days. 5. (*a*) 26983.
(*b*) Piano cost £37. 5*s*. 2*d*., table £17. 9*s*. 7*d*., carpet £8. 10*s*. 9*d*.

XXII. Page 20.

1. (*a*) 45850. (*b*) 64 yrs. 2. (*a*) 7*d*. (*b*) 1*s*. 4*d*.
3. (*a*) 104 boxes of each size. (*b*) £371. 18*s*. 11*d*.
4. (*a*) 6440. (*b*) 3*s*. 4*d*. 5. (*a*) £13. 2*s*. 6*d*.
(*b*) 428640 grs. (*c*) 50 dolls. 3 dimes 2 mills. (2) 24107.

XXIII. Page 21.

1. (*a*) 605551. (*b*) £3. 3*s*. 1*d*. too much. 2. (*a*) 11043.
(*b*) eldest son's portion = 512 ac., portion of each of other sons = 256 ac. 3. (*b*) 39 yds. 2 qrs. 1 nl. ¼ in.
4. (*a*) Mr Johnson owes Mr Mould £28. 6*s*. 6½*d*.
(*b*) (1) £380. 12*s*. 6*d*. (2) £83. 15*s*. 3¼*d*. 5. (*a*) 4*d*.
(*b*) 4 c. (*c*) 2*s*. 3*d*., £11250.

XXIV. Page 22.

1. (*a*) Four thousand five hundred and eighty-one millions one hundred and fifty-eight thousand one hundred and one.
(*b*) 2*s*. 11*d*. 2. (*a*) £4. 10*s*. (*b*) £2. 5*s*. 4*d*.
(*c*) £2. 3*s*. 4*d*. 3. (*a*) 66 lbs. 10 oz. 1 dwt. 16 grs.
(*b*) 4 tons 13 cwt. 25 lbs. 8 oz. (*c*) £1. 9*s*. 2¼*d*.
4. (*a*) 18 days. (*b*) £625078. 4*s*. 4½*d*.
5. (*a*) 140 of each. (*b*) 9 women. (*c*) 12*s*. 5*d*.

XXV. Page 23.

1. (*a*) 1407, 41300 rem^{r}. 1. (*b*) 2731 fr. 56 c. 2. (*a*) 1*s*. 5¾*d*.
(*b*) (1) 14080 yds. (2) 640 chs. (3) 8 mi.
3. (*a*) 11 each had £3. 2*s*. 5¼*d*., and 4 each £6. 4*s*. 10½*d*.
(*b*) 19 times. 4. (*b*) 4 mi. 2 fur. 17 po.
5. (*a*) 247½ lbs. of tea, 1897½ lbs. of sugar, 2530 lbs. of rice, 759 lbs. of coffee. (*b*) 6*s*. 3½*d*.

XXVI. Page 24.

1. (*a*) None. (*b*) 909. 2. (*a*) £7. 10*s*., £390.
(*b*) He lost 16*s*. 10¾*d*. 3. (*b*) 4½ dozen. 4. (*a*) £3. 8*s*. 3*d*.
(*b*) 176 dolls. 11 cents. 5 mills. 5. (*a*) *A*'s share = £1. 1*s*. 3*d*., *B*'s = £1. 5*s*. 6*d*., *C*'s = £3. 10*s*. 1½*d*. (*b*) 42 men.

XXVII. Page 25.

1. (*a*) 675 fr. 70 c. (*b*) 32 days. 2. (*b*) £2. 2*s*.
3. (*a*) £1496. 16*s*. 6*d*. (*b*) £1465. 16*s*. 8*d*.
4. (*a*) 336, rem^{r}. 17. (*b*) No. = 125. 5. (*a*) (1) 8 days; (2) 4½ days. (*b*) 9 hrs. 36 min.

XXVIII. Page 26.

1. (*a*) 347, 2629, 3200104. (*b*) 7481.
2. (*a*) 24 men, 17 women, 41 boys.
(*b*) 1st field = 12 ac. 2 ro. 25 po., 2nd field = 25 ac. 1 ro. 10 po., 3rd field = 75ac. 3 ro. 30 po. (*c*) £3. 18*s*.
3. (*a*) The last two are longer by 172800″. (*b*) 5189 sheets.
(*c*) 1680 turns.
4. (*a*) *C* has to pay *A* 8*s*. 10*d*., and *B* £1. 6*s*. 8½*d*.
(*b*) 100 lbs., 2*s*. 8*d*. 5. (*a*) 4*s*. 11*d*. (*b*) 35 days.

XXIX. Page 27.

1. (*a*) £912500. (*b*) 892 fr. 32 c. 2. (*a*) £86. 7*s*.
(*b*) 360 mi., 160 hrs. (*c*) 3543 in. 3. (*a*) product = 51250.
(*b*) (1) 5071 times. (2) 920981 must be added.
4. (*a*) Value of 1 dozen of wine = £2. 3*s*. 4¼*d*. (*b*) 34 dresses.
5. (*a*) 91 hats. (*b*) £14834. 4*s*.

XXX. Page 29.

1. (*a*) 1765 yds. 1 ft. 6 in. (*b*) 7 in.
2. (*b*) 5 scored 9 each, 2 scored 20 each, 2 scored 14 each, and 1 scored 35. 3. (*a*) 36. (*b*) 34 women, 2 lbs.
4. (*a*) No. of girls = 106. (*b*) 1430899 min.
5. (*a*) Value of tea = £969. 7*s*. $11\frac{1}{2}$*d*. (*b*) Gain = £7. 16*s*. $1\frac{1}{4}$*d*.

XXXI. Page 29.

1. (*a*) *A* has 13*s*. 7*d*. more than *B*. (*b*) £1. 6*s*.
2. (*a*) 7 days. (*b*) 4 lbs., $2\frac{1}{4}$ lbs.
3. (*a*) Cost of the wine = £61. 5*s*., Profit = £19. 4*s*. 9*d*.
(*c*) 57 houses. 4. (*a*) £22. 15*s*. (*b*) £10. 9*s*. 8*d*.
5. (*a*) £1264. 1*s*. $10\frac{1}{2}$*d*. (*b*) £239. 9*s*. 10*d*.

XXXII. Page 30.

1. (*a*) 7124 and 5516.
(*b*) Each man receives £4. 4*s*., each woman £3, and each child £1. 16*s*.
2. (*a*) The 1st man ought to receive 482 bus. 1 pk. 4 qts. 1 pt. The 2nd man 160 bus. 3 pks. 1 qt. 1 pt. The 3rd man 321 bus. 2 pks. 3 qts. (*b*) 4 mi. 7 fur. 2 po. 2 yds. 2 ft. 3 in.
3. (*a*) 1 lb. of tea = 5*s*. (*b*) 1*s*. 5*d*. 4. (*a*) 3 dolls.
(*b*) (1) £1009. 15*s*. 5*d*.; (2) £57. 2*s*. $2\frac{1}{4}$*d*.
5. (*a*) 350 ac. (*b*) 15 yds. 1 nl. $1\frac{1}{4}$ in., 19 yds. 3 qrs. 2 in.
(*c*) £1. 16*s*. 8*d*. (*d*) 70.

XXXIII. Page 31.

1. (*a*) 108. (*b*) £2926838. 6*s*. 8*d*. 2. (*a*) £863.
(*b*) 30 yds. 3. (*a*) (1) £79. 8*s*. $1\frac{1}{2}$*d*. (2) £4045. 5*s*. $8\frac{3}{4}$*d*.
(*b*) *A*'s share = £77. 13*s*. 3*d*., *B*'s = £51. 15*s*. 6*d*.
4. (*a*) *A* must pay £1. 9*s*., *B* and *C* 19*s*. 4*d*. each, *D* £1, 18*s*. 8*d*.
(*b*) *A* will have 10 ac., *B* will have 1 ro., and *C* will have 1 po. $9\frac{3}{4}$ sq. yds. 5. (*a*) 21 tons 1 cwt. 1 qr. 24 lbs.
(*b*) $13\frac{1}{2}$ ac. 6. (*a*) 18. (*b*) 65371754 tons, 10 cwt.

XXXIV. Page 33.

1. (*a*) 420. (*b*) £660. 2. (*a*) $54\frac{1}{2}$; $\frac{693}{56}$;

(*b*) (1) $\frac{720}{960}$, $\frac{1600}{960}$, $\frac{384}{960}$, $\frac{960}{960}$, $\frac{33}{960}$. (2) $\frac{2}{13}$, $\frac{4}{9}$.

3. (1) $\frac{3}{4}$; (2) $1\frac{17}{18}$; (3) $4\frac{19}{42}$; (4) $21\frac{3}{16}$; (5) $\frac{75}{452}$; (6) $8\frac{29}{100}$.

4. (*a*) $1\frac{17}{24}$. (*b*) $6\frac{1}{4}$ gal^{s}. 5. (*a*) 6*s*. 3*d*. (*b*) 180.
(*c*) $37\frac{1}{3}$ bus. 6. (*a*) $\frac{1}{3}, \frac{35}{176}$. (*b*) £1000.

XXXV. Page 34.

1. (1) 72; (2) 15; (3) 5; (4) 5.

2. (*a*) (1) $\frac{61}{86}$; (2) $\frac{47}{1}$; (3) $\frac{517}{11}$.

(*b*) (1) 60; (2) 4750; (3) $1\frac{7}{8}$; (4) $4\frac{11}{16}$; (5) $\frac{1}{4}$; (6) 4.

3. (*a*) $\frac{96}{240}, \frac{72}{240}, \frac{112}{240}$ and $\frac{135}{240}$; $\frac{120}{300}, \frac{135}{300}, \frac{140}{300}$, and $\frac{56}{300}$; $\frac{85}{60}, \frac{210}{60}, \frac{168}{60}$ and $\frac{40}{60}$. (*b*) 15, 13, rem^{r}. $\frac{1}{10}$ of orange; 9, 4 rem^{r}. $\frac{1}{30}$ of orange. 4. (*a*) (1) $\frac{1120}{1511}$; (2) $19\frac{1}{10}$; (3) $10\frac{23}{90}$; (4) $3\frac{29}{30}$; (5) $6\frac{13}{50}$; (6) $2\frac{29}{30}$; (7) 4. 5. (*a*) $\frac{3}{8}$. (*b*) £8. 13*s*. 5*d*., 1*s*. $0\frac{1}{2}$*d*. (*c*) 68 shots, $\frac{1}{3}$ oz. 6. (*a*) 4 cwt. 3 qrs. 14 lbs.; $\frac{17}{55}$. (*b*) £9. 13*s*. 6*d*. (*c*) (1) $5\frac{1}{4}$*d*.; (2) 9*s*.

XXXVI. Page 36.

1. (*a*) G.C.M. = 24, L.C.M. = 113832. (*b*) 82 heaps of wheat, 124 heaps of barley, 173 heaps of oats; 6 qrs. in 1 heap.

2. (*a*) (1) 1; (2) $\frac{507}{719}$; (3) $\frac{1}{3}$; (4) $10\frac{8}{9}$; (5) $\frac{12}{95}$; (6) $\frac{3}{14}$.

3. (*b*) $\frac{5}{504}, \frac{43}{48}$ of 1 lb. Troy, $\frac{129}{175}$ of 1 lb. Avoird. (*c*) $\frac{37}{72}$.

4. (*a*) (1) $4\frac{14}{75}$; (2) $6\frac{4}{7}$; (3) $9\frac{99}{140}$; (4) $24\frac{16}{81}$; (5) $\frac{2}{5}$.
(*b*) 1 ro. 15 po. 17 sq. yds. 5 sq. ft. $57\frac{3}{5}$ sq. in.

5. (*a*) $4\frac{15}{64}$. (*b*) *A* has 48*s*., and *B* 36*s*. (*c*) $1\frac{38}{85}$ days.

XXXVII. Page 37.

1. 63 ac., *A* can mow it in 90 days, *B* in 63 days, *C* in 70 days.

2. (*a*) $\frac{432}{56}$, 205. (*b*) (1) $\frac{41}{51}$; (2) 1890; (3) $\frac{55}{392}$; (4) $\frac{1}{72}$; (5) 396.

3. (*a*) (1) £2. 13*s*. 11*d*.; (2) 2 days 4 hrs. 12 min. 44 sec.; (3) 5 ac. 2 ro. 12 po. 13 sq. yds. 4 sq. ft. (*b*) (1) $\frac{5}{24}$; (2) $\frac{20107}{63360}$; (3) $\frac{97}{125}$. 4. (*a*) (1) $15\frac{213}{260}$; (2) $32\frac{113}{128}$; (3) $18\frac{153}{220}$; (4) $\frac{14167}{25488}$; (5) $\frac{4336}{58881}$.

5. (*a*) 8 days, $1\frac{1}{3}$ day. (*b*) $\frac{16}{45}$. (*c*) £3. 12*s*.

XXXVIII. Page 39.

1. 1009. 2. (*a*) (1) $\frac{6}{7}$ of 1 guin^{a}. by 1*s*. 4*d*.

(2) $3\frac{2}{5}$ of 11 cwt. 6 lbs. by 6 cwt. 1 qr. $7\frac{29}{45}$ lbs. (*b*) $A = \frac{2}{27}$ of B.

3. (*a*) $\frac{23}{100}$. (*b*) $\frac{119}{3200}$. 4. (*a*) £23. 11*s*. $3\frac{3}{4}$*d*. $\frac{8}{21}$ *q*.
(*b*) £42. 14*s*. $7\frac{5}{192}$*d*. (*c*) $4\frac{4}{7}$. 5. (*a*) $\frac{37}{650}$.
(*b*) $97\frac{1}{2}$ pks. (*c*) $2\frac{5}{8}$ days.

XXXIX. Page 40.

1. 12 hrs. 2. 1. (*b*) $\frac{8}{5}$. 3. (*a*) £40. 19*s*. (*b*) £19. 4*s*.
(*c*) Each man has 3*s*., each woman 2*s*., and each boy 1*s*. 4*d*.
4. (*a*) $11\frac{3}{20}$. (*b*) $5\frac{2}{15}$. (*c*) (1) $6\frac{13}{30}$. (2) $\frac{2}{167}$.
5. (*a*) £18. (*b*) £1775. (*c*) £21.

XL. Page 41.

1. (*a*) Seventy thousand millions five hundred and thirty thousand and two. (*b*) 213004.
2. (*a*) (1) 36 dozen; (2) $7\frac{1}{2}$*d*. (*b*) gain = 15*s*. $6\frac{1}{2}$*d*.
3. (*a*) She lost 1*s*. $6\frac{1}{4}$*d*. (*b*) 18. 4. (*a*) (1) 48; (2) 126; (3) 4; (4) 6. (*b*) (1) 180; (2) 2400.
5. (*a*) $\frac{97}{9}$, $4\frac{9}{16}$. (*b*) 7 apples. (*c*) (1) $2\frac{29}{40}$; (2) $30\frac{64}{105}$; (3) $2\frac{41}{42}$.

XLI. Page 42.

1. (*a*) £91. 7*s*. $3\frac{1}{2}$*d*. (*b*) Average daily attendance = 48.
2. (*a*) 1080. (*b*) 135360 min. (*c*) 20 wks.
3. (*a*) (1) 490; (2) 210; (3) 1260. (*b*) 14.
4. 27 ninths. (*a*) (1) $\frac{48}{175}$; (2) $\frac{25}{38}$; (3) $\frac{2}{11}$; (4) $\frac{1705}{4}$.
(*b*) He gave away £32, he had left £48. (*c*) (1) $1\frac{4}{5}$;
(2) $23\frac{14}{15}$; (3) $21\frac{29}{30}$; (4) $26\frac{3}{10}$; (5) $9\frac{1}{30}$; (6) $24\frac{7}{10}$.
5. (*a*) 13 yrs. (*b*) £5. 16*s*.

XLII. Page 44.

1. (*a*) £3. 3*s*. 4*d*. (*b*) £541. 17*s*. 6*d*.
2. (*a*) £87. 19*s*. $3\frac{1}{4}$*d*. (*b*) 2 hr. 20 min. P.M., $262\frac{1}{2}$ mi. from *B*.
3. (*a*) G.C.M. = 9, L.C.M. = 2702592.
(*b*) 29 florins, 87 half-crowns, 116 fourpenny pieces.
(*c*) £115. 10*s*. 4. (*a*) (1) $\frac{21}{22}$; (2) $\frac{56}{126}$.
(*b*) $\frac{126}{168}$, $\frac{21}{168}$, $\frac{48}{168}$, $\frac{476}{168}$, $\frac{60}{168}$. (*c*) $\frac{8}{25}$.
5. (*a*) 40. (*b*) 1000. (*c*) $\frac{14}{33}$ of farm.

XLIII. Page 45.

1. (*a*) 357742429936128 48. (*b*) £4. 8*s*. 6*d*. (*c*) 2*s*. 4*d*.
2. (*a*) £268. 19*s*. $6\frac{1}{2}$*d*. (*b*) 9 days. 3. (*a*) 66.
(*b*) L.C.M. = 187110, G.C.M. = 97. 4. (*a*) 73938 lks.
(*b*) 10 gallons. 5. Diff. = $2\frac{1}{3}$. (*a*) (1) $5\frac{8}{11}$;
(2) $20\frac{17}{70}$; (3) $199\frac{33}{50}$; (4) $15\frac{19}{24}$; (5) $\frac{1}{44}$; (6) 224.
(*b*) 117 times, 3 qts. (*c*) 300 gal^{s}.

XLIV. Page 46.

1. (*a*) (1) 717; (2) 110028; (3) 71.
(*b*) 10 oz. 6 drs. 2 scr. 14 grs. 2. (*a*) $8\frac{1}{4}$ hrs. (*b*) £8. 8*s*.
3. (*a*) 142 panels. (*b*) 54 families. 4. (*a*) (1) $\frac{57}{77}$;
(2) $1\frac{89}{99}$; (3) $\frac{32}{99}$; (4) $\frac{19}{33}$. (5) 2. (*b*) $193\frac{41}{56}$.
5. (*a*) 1 bus. (*b*) $2\frac{3}{5}$. (*c*) £100.

XLV. Page 47.

1. (*a*) Size of field = 8 ac. 12 po. ¼ sq. yd.; value of produce = £97. 9*s*. 7½*d*. (*b*) 4800. 2. (*a*) £680. 2*s*. 1½*d*. (*b*) £16007. 5*s*. 3. 11 classes of girls, 17 classes of boys. (*a*) (1) $\frac{23}{24}$ is the greatest, and $\frac{7}{15}$ is the least. (2) $\frac{1277}{8400}$. (*b*) 28. 5. (*a*) (1) 684268. (2) $\frac{16}{119}$. (3) $\frac{40}{63}$. (4) 2. (*b*) (1) £67. 1*s*. 1*d*. (2) 15 hrs. 28 min. 48 sec.; 6 fur. 34 po. 1 yd. 1 ft. $8\frac{4}{7}$ in.

XLVI. Page 49.

1. (*a*) 1894 mi. 226 yds. 2 ft. (*b*) £117. 8*s*. 3¾*d*.
2. (*a*) £38291. 13*s*. 4*d*. (*b*) 25 inmates.
3. (*a*) £156. 4*s*. 10½*d*. and £104. 3*s*. 3*d*. (*b*) 6 in.
4. (1) $\frac{3}{8}$; (2) $2\frac{109}{1092}$; (3) $\frac{151}{1092}$; (4) 9. 5. (*a*) $7\frac{3}{13}$. (*b*) 972.

XLVII. Page 50.

1. (*a*) 762, rem^{r}. 81. (*b*) (1) 5787; (2) 7001; (3) 59.
2. (*a*) 5¾*d*. (*b*) 13*s*. 1½*d*. 3. (*a*) 2 min. 15 sec. (*b*) £35. 3*s*. 1½*d*. 4. (*a*) (1) 3 children, $\frac{1}{15}$ of orange; (2) $\frac{3}{4}$ is greater than $\frac{2}{3}$ by $\frac{1}{12}$. (*b*) The fractions are $\frac{52}{650}$, $\frac{195}{650}$, $\frac{91}{650}$, $\frac{80}{650}$; $\frac{66}{325}$. 5. (*a*) (1) $1\frac{128}{183}$; (2) $18\frac{1154}{2025}$; (3) $2\frac{319}{405}$; (4) $\frac{6}{25}$. (*b*) $\frac{3691}{4095}$. (*c*) £7.

XLVIII. Page 51.

1. (*a*) 1090638. (*b*) £10. 12*s*. 0¾*d*. 2. (*a*) 5.35 P.M., 169 mi. 502 yds. $2\frac{4}{7}$ ft. from Edinburgh. (*b*) £2. 6*s*. 3*d*.
3. (*a*) (1) $25\frac{2}{3}$; (2) $\frac{2}{1029}$; (3) $\frac{58}{101}$. (*b*) (1) $\frac{1925}{6804}$; (2) 2 days, 5 hrs. 23 min. 16 sec. 4. (*a*) 9 qrs. (*b*) £56. 5*s*., and £43. 15*s*. 5. (*a*) 50 yds. (*b*) 9 hrs.

XLIX. Page 52.

1. (*a*) *A* will have 4 ac. 28 po. 12 sq. yds., *B* 6 ac. 1 ro. 2 po. 18 sq. yds., *C* 15 ac. 2 ro. 26 po. $14\frac{3}{4}$ sq. yds. (*b*) The 1st gains 2*s*. $3\frac{1}{2}$*d*. more than the 2nd. 2. (*a*) (1) $\frac{11}{37}$. (2) 20; (3) $5\frac{65}{154}$; (4) $11\frac{1999}{2464}$; (5) $70\frac{793}{1260}$. (*b*) sum $=1\frac{7}{55}$, quotient $=1\frac{2}{27}$. 3. (*a*) $61\frac{1}{4}$ bus. (*b*) $\frac{11}{20}$ ths, $\frac{1}{5}$ th.
4. (*a*) *B*'s share = £3084. 15*s*., value of mine = £9871. 4*s*. (*b*) $3\frac{7}{8}$. *5.* (*a*) gain = 18*s*. 4*d*. (*b*) (1) 10*d*.; (2) $\frac{7}{15}$.

L. Page 53.

1. (*a*) 6578845096. (*b*) $2\frac{3}{4}$*d*. 2. (*a*) no. of ac. = 1856, price per ac. = £10. 10*s*. (*b*) 2160. 3. (*a*) an apple cost $\frac{3}{4}$*d*., an apricot $4\frac{1}{4}$*d*. (*b*) 1 ac. 2 ro. 5 po. $5\frac{3}{4}$ yds. 3 ft. 72 in.; 57 more plots can be taken, and there will remain 3 sq. yds. 2 sq. ft. 42 sq. in. 4. (*a*) (1) $20\frac{12}{13}$; (2) $173\frac{5}{18}$; (3) 3108. (*b*) 360. 5. (*a*) $\frac{37}{96}$ of the cistern. (*b*) $\frac{9}{14}$ and $\frac{16}{63}$, quotient $=2\frac{17}{57}$.

LI. Page 55.

1. (*a*) £7. 11*s*. $10\frac{1}{2}$*d*. (*b*) 12*s*. 6*d*. in the £.
2. (*a*) (1) £188. 8*s*.; (2) £1122. 6*s*. $10\frac{3}{4}$*d*. $\frac{1}{8}$*q*.
3. (*a*) £57. 17*s*. $7\frac{1}{2}$*d*. (*b*) 8*s*. 9*d*. (*c*) 14 Turkeys and 14 Geese. 4. (*a*) (1) $\frac{90}{186}$; (2) 305 cwt. 11 lbs. $4\frac{1}{84}$ oz.
(*b*) (1) $\frac{10}{11}$ is the greatest, $\frac{9+10}{10+11}$ next, $\frac{9}{10}$ least;
(2) $\frac{1}{231}$. (*c*) (1) $\frac{1}{8800}$; (2) $\frac{5}{1944}$.
5. (*a*) 52 women. (*b*) 10 mo.

LII. Page 56.

1. (*a*) ·7, ·66, ·03, ·00061, 16·005, 950·000999.
(*b*) ·104, ·0073, ·000601, 6·04, 75·00037, 500·20002002.
2. (*b*) 6, 600, 600000. (*c*) ·06, ·0006, ·0000006.

3. (1) 1243·3776; (2) 202·15674; (3) 24·9691; (4) 4·889; (5) 4·872; (6) ·04872; (7) 48720. 4. (*a*) $161, 8 dimes, 2 cents. 2 mills; (*b*) 3 fr. 93 c. 5. (*a*) 276·007497. (*b*) £12. 2*s*. 3*d*. (*c*) 232 fr. 50 c.

LIII. Page 57.

1. One hundred. (*a*) ·16, 1·6, ·00016, 27·0017, 60·61, 403·004. (*b*) 200·0019, 2·0000003, 6000·00084, 19.

2. (*a*) (1) $15, 19 c. 7 mills = $15·197 = 1519·7 c. = 15197 mills;
   (2) $4, 4 c. = $4·04 = 404 c. = 4040 mills;
   (3) 14 mills = $·014 = 1·4 c. = 14 mills.
 (*b*) (1) 54 fr. 2 c. = 54·02 fr. = 5402 c.;
   (2) 45 fr. = 45 fr. = 4500 c.;
   (3) 5 fr. 27 c. = 5·27 fr. = 527 c.;
   (4) 5 c. = ·05 fr. = 5 c.

3. (*a*) (1) 580·55755575; (2) 1323·22412025; (3) 991·09;
   (4) 27·4945494; (5) ·0100325; (6) 1003·25;
   (7) 1·00325; (8) ·575; (9) ·0575; (10) 57500000.
 (*b*) (1) 5012 fr. 90 c.; 26999·973. 4. (*a*) $1, 9 dimes, 9 cents. 9 mills; (2) 7 dimes, 4 cents. 8 mills; (3) 7 fr. 14 c.
 (*b*) 4·500941. (*c*) (1) 16·21987; (2) 1621·987;
   (3) 162198·7; (4) ·1621987; (5) ·00001621987.

5. (*a*) (1) ·0006875; (2) 15·222464; (3) 3·6; (4) 20007.
 (*b*) 3·3333, 14·9411. (*c*) (1) ·875 of 10*s*. 6*d*. = 9*s*. 2¼*d*., ·785 of 13*s*. 4*d*. = 10*s*. 5½*d*. $\frac{2}{5}q$. (*d*) (1) ·040625;
   (2) ·000040625.

LIV. Page 59.

1. (*a*) $\frac{2}{5}$; $\frac{9}{250}$; $2\frac{1}{20}$; $500\frac{709}{100000}$; $53\frac{1}{1000000}$.

 (*b*) Fifteen hundredths, nine hundred and fifteen ten-thousandths, seven hundred and eighty hundred-thousandths, twelve and forty-three-thousandths, seven and seven millions nine hundred and fifty one thousands five hundred and six hundred-millionths.

 (*c*) (1) 2500·7; (2) 2500700; (3) 2500700000.
 (*d*) (1) ·000000082, ·0000000000082; (2) ·791, ·0000791.

2. (*a*) (1) $14, 9 cents. = $14·09 = 140·9 dimes = 14090 mills;
   (2) $71, 4 mills = $71·004 = 710·04 dimes = 71004 mills;
   (3) 6¼ cents. = $·0625 = ·625 dimes = 62·5 mills.
 (*b*) $124·05 = $124, 5 cents.; (2) $54·506 = $54, 5 dimes, 6 mills; (3) $6·48½ = $6, 4 dimes, 8 cents. 5 mills; (1) 6·05 fr. = 6 fr. 5 c.; (2) ·0125 fr. = 1¼ c.; (3) 37½ fr. = 37 fr. 50 c.

3. (*a*) $9789, 2 cents. 6 mills. (*b*) 3500 fr. 5 c.
4. (*a*) he lost 18 fr. 1·875 c. (*b*) 40. 5. (*a*) (1) ·264; (2) ·85; (3) 3·2976; (4) 9·00875. (*b*) (1) 3 pks. 1 gal. 1 pt.; (2) £2. 6*s*. 9*d*. (*c*) (1) ·1375, ·055; (2) ·603125, ·24125.

LV. Page 60.

1. (1) three hundred-thousandths; (2) three hundredths. (*a*) two and one ten-thousandths, seven hundred and forty-two and four-tenths, fifty-four and twenty-six-hundredths, one hundred and four hundred thousandths.

(*b*) £20. 5 c. 4 m. = £20·054 = 200·54 fl. = 2005·4 c. = 20054 m. £100·105 m. = £100·105 = 1001·05 fl. = 10010·5 c. = 100105 m. 7 c. 6 m. = £·076 = ·76 fl. = 7·6 c. = 76 m. 15 fl. 15 m. = £1·515 = 15·15 fl. = 151·5 c. = 1515 m. £4. 3 m. = £4·003 = 40·03 fl. = 400·3 c. = 4003 m. 2. (*a*) ·4587. (*b*) 421·425309. (*c*) ·002. 3. (*a*) 2050 fr. 92 c. (*b*) (1) 16981·81681; (2) 918·108466275. (*c*) 553 fr. 39¾ c. 4. (*a*) (1) ·65, ·00065, 6500; (2) 650, ·65, 6500000. (*b*) (1) ·0016; (2) ·0539. (*c*) 101 fr. 50. c. 5. (*a*) $2\cdot\dot{8}82352941176470\dot{5}$. (2) 19·000048828125; (3) 17·05; (4) $28\cdot7708\dot{3}$. (*b*) ·015625. (*c*) £6. 1*s*. 6*d*.; he gave for the sheep $\cdot\dot{5}$ of his money, and for the pig $\cdot1\dot{6}$ of his money.

LVI. Page 61.

1. (*a*) $\frac{16}{33}$; $\frac{1}{111}$; $\frac{1}{99}$; $7\frac{22242}{33333}$. (*b*) (1) 15*s*.; (2) 1 ac. 3 ro. 5 po. 21 sq. yds. 5 sq. ft. $66\frac{6}{7}$ sq. in. 2. (*a*) $\cdot556\dot{8}\dot{1}$. (*b*) 1·05; (2) $2\cdot067\dot{3}0769\dot{2}$; (3) 14·0848. 3. (*a*) ·6. (*b*) 2·004. 4. (*a*) *A* has £360, *B* £270, and *C* £240. 5. (*a*) 18*s*. (*b*) 80·12 ac.

LVII. Page 62.

1. (*a*) $\frac{28}{45}$; $\frac{11}{1500}$; $2\frac{19}{55}$; $\frac{12922}{24775}$; $17\frac{7}{440}$. (*b*) (1) 9*s*. 7*d*.; (2) 5 po. 4 yds. 2 ft. 6 in. (*c*) (1) 2 tons 7 cwt. 1 qr. 7 lbs. 8 oz.; (2) ·125. 2. (*a*) (1) 5·077881. 3. (*a*) 6 min. 13·8 sec. (*b*) 16*s*. 9¾*d*. 4. (*a*) 569 ac. 2 ro. 29 po. (*b*) 168. 5. (*a*) 14·569588, ·189526. (*b*) $1\cdot471003\dot{7}$, $\cdot\dot{7}\dot{2}$.

LVIII. Page 63.

1. 2·3125 of 4*s*. is the greater by $1\frac{2}{5}d$. 2. (1) 40·2175; (2) 145·1. 3. (*b*) 7157·3025 in. 4. (*a*) ·80952. (*b*) 5·79424... (*c*) G.C.M. = ·000279, L.C.M. = 25234·718.
5. (*a*) 9*s*. $1\frac{1}{2}d$. (*b*) £257. 3*s*. $10\frac{1}{2}d$., 1·00125... (*c*) *A*'s property exceeds *B*'s by £4900.

LIX. Page 64.

1. One thousand one hundred and twenty millions two hundred thousand three hundred and four. (*a*) 9 qrs.
(*b*) *A* had travelled 33 mi. 17 po. 2 yds. 1 ft. 6 in., and *B* 15 mi. 4 fur. 25 po. 1 yd. 2 ft., *A*'s speed per hr. = 4 mi. 1 fur. 2 po. 1 yd., and *B*'s speed per hr. = 3 mi. 37 po. 1 ft. 2. (*a*) 5*s*. 11*d*., 8*s*. $1\frac{1}{4}d$. (*b*) 2522 nuts. 3. (*a*) $12\frac{1}{5}$. (*b*) $22\frac{439}{448}$. (*c*) (1) £11025, (2) £14700. 4. (*a*) 4010, ·0605109. (*b*) $\frac{80}{2121}$, ·037718... (*c*) 28·375, and 21·625. 5. (*a*) 18 days. (*b*) $8\frac{7}{16}$ hrs.

LX. Page 65.

1. 19892, rem^{r}. 16. (*a*) 5*s*. 9*d*. (*b*) (1) £10. 3*s*. 9*d*. (2) $\frac{3}{4}d$.
2. (*a*) 8791 lbs. 8 oz. $5\frac{41}{81}$ drs. (*b*) (1) £868. 11*s*. $2\frac{1}{4}d$. $\frac{3}{5}q$.; (2) £7. 3*s*. $7\frac{1}{4}d$. ·90625*q*. 3. (*a*) (1) $\frac{968}{11025}$; (2) $9\frac{29}{30}$; (3) $2\frac{2}{15}$. (*b*) (1) 10 times; (2) $\frac{2606}{7371}$.
4. (*a*) $3\frac{3}{4}d$. (*b*) 11*s*. 8*d*. 5. (*a*) 3·8882576. (*b*) (1) $\cdot 45486\dot{1}$; (2) ·30472.... (*c*) $22\frac{13888886}{27777775}$ in.

LXI. Page 66.

1. (*a*) 24, rem^{r}. 5397; 24 fur. 27 po. 1 yd. 1 ft. 3 in. (*b*) 57.
2. (*a*) 20 wks. (*b*) $\frac{3}{4}$ ac. 3. (*a*) $\frac{1897}{5940}$ of the distance. (*b*) *B*'s share = 23 qrs. 4 bus. 4. (*a*) (1) $\frac{173}{440}$; (2) $\frac{13}{27}$; (3) $15\frac{1}{66}$. (*b*) (1) ·0166375; (2) ·221.
5. (*a*) £129. 18*s*. $7\frac{1}{4}d$. $\frac{43}{56}q$. (*b*) ·523...

LXII. Page 67.

1. (*a*) 112 tons. (*b*) 64 ells.
2. (*a*) 66150140.
   (*b*) $464 = 2 \times 2 \times 2 \times 2 \times 29$; $825 = 3 \times 5 \times 5 \times 11$; $999 = 3 \times 3 \times 3 \times 37$; $2366 = 2 \times 7 \times 13 \times 13$.
3. (*a*) 120; $34\frac{2}{9}$.
   (*b*) $\frac{3}{4}$ of $1\frac{3}{10}$ is greater by $\frac{1}{1560}$; product $= \frac{1}{200}$.
4. (*a*) 28 kilom. 4 hectom. 7 dekam. 5 m. (*b*) £7. 6*s*. $6\frac{3}{4}$*d*.
5. (*a*) ·30375. (*b*) 10065 times; $\frac{3}{8}$ pt. (*c*) 69 eggs.

LXIII. Page 68.

1. (*a*) 51; rem^r. = 2. (*b*) $2017. 47 cents.
2. (*a*) 36498924 sq. in.; 843 ac. 2 ro. 35 po. (*b*) 10*s*.
3. (*a*) £1. 3*s*. 3*d*.
   (*b*) 5 bus. $3\frac{1}{3}$ pks. is $\frac{376}{1043}$ part of 2 qrs. 1 pk. 3 pts.
   (*c*) (1) *A* owns 3571 ac. 14 po., *B* owns 1080 ac. 23 po., and *C* owns 2292 ac. 2 ro. 8 po.; (2) *C*'s share is $\frac{183404}{285687}$ of *A*'s share; (3) £124547. 3*s*. 9*d*.
4. (*a*) (1) $\frac{1363}{13440}$; (2) $\frac{120}{221}$. (*b*) £2. 0*s*. 10*d*.
5. (*a*) 2·21484375 times. (*b*) 8 yds. 2 qrs. 1·247... nls.
   (*c*) 16 hrs. 48 min.

LXIV. Page 69.

1. (*a*) £56. 13*s*. 4*d*. (*b*) 3*s*. $10\frac{3}{4}$*d*.
2. (*a*) 29921; 140178. (*b*) 1534478785; 15346322328785.
3. (*a*) £14. 9*s*. $7\frac{1}{2}$*d*. (*b*) (1) 8064 lit.; 7 tuns; (2) £537. 12*s*.
4. (*a*) (1) $\frac{2}{135}$; (2) $\frac{4}{45}$.
   (*b*) (1) $\frac{16}{120}$; $\frac{21}{120}$; $\frac{1}{24}$; (2) $1\frac{4}{5}$; $\frac{2}{15}$.
5. (*a*) $\frac{223}{1108800}$. (*b*) (1) ·00112896; 11·2896.
   (2) 842·75; 8427500000; (3) $36 \cdot \dot{5}6\dot{7}$. (*c*) 144.

LXV. Page 71.

1. (*a*) £388. 0*s*. $4\frac{1}{4}$*d*. $\frac{1}{4}$*q*.; £19. 11*s*. $8\frac{3}{4}$*d*. $\frac{3}{10}$*q*. (*b*) 79.
2. (*a*) 57. (*b*) £180.
3. (*a*) (1) £21; (2) 59 casks.
4. (*a*) 360. (*b*) £1. 10*s*. $0\frac{1}{2}$*d*. $\frac{7}{24}$*q*.
5. (*a*) 134999·99755. (*b*) 5. (*c*) $\cdot 00\dot{2}47\dot{5}\ldots$

LXVI. Page 72.

1. (*a*) $60=2\times2\times3\times5$; $126=2\times3\times3\times7$;
$1960=2\times2\times2\times5\times7\times7$; L.C.M.$=17640$. (*b*) 12*s*. 1*d*.
2. (*a*) 12*s*. 6*d*.; £2346. 12*s*. 6*d*.
(*b*) (1) *A* came in 1st, *C* 2nd, and *B* 3rd;
(2) 3 mi. 1056 yds.
3. $\frac{35}{72}$. (*a*) (1) $\frac{2}{3}$; (2) 4; (3) $\frac{122}{275}$.
(*b*) $\frac{64}{75}$ ac., or 3 ro. 16 po. $16\frac{2}{15}$ yds.
4. (*a*) 578 fl. 3·125 mills; 1436 fr. 40·765625 c.
(*b*) (1) 1*s*. $8\frac{4}{25}$*d*.; (2) 1 ro. 7 po. $1\frac{6}{25}$ yds.
5. (*a*) $5\frac{3}{4}$*d*. (*b*) 5 sheep at £2. 16*s*. each, 15 lambs at £1. 8*s*. each, and 30 pigs at 18*s*. 8*d*. each. (*c*) 18 hrs.

LXVII. Page 73.

1. 29763, rem^r. 1661.
2. (*a*) 16*s*. $10\frac{1}{2}$*d*. (*b*) 2*s*. $2\frac{1}{4}$*d*. (*c*) 1*d*.
3. (*a*) £20. (*b*) $\frac{3}{13}$, £28. 15*s*. 9*d*.
4. (*a*) 283 fr. 95 c. (*b*) (1) $7\frac{5}{18}$; (2) $1\frac{71}{182}$.
5. (*a*) 8*s*. 2*d*. (*b*) 5 mi. (*c*) £2. 13*s*. 6*d*.

LXVIII. Page 75.

1. (*a*) gain = £4. 17*s*. (*b*) £899. 1 fl. 9 c. $3\frac{3}{4}$ m.
2. (*a*) *A*'s share = 154 ac. 3 ro. 2 po. $25\frac{1}{3}$ sq. yds., *B*'s = 619 ac. 11 po. $11\frac{1}{4}$ sq. yds., and *C*'s = 773 ac. 3 ro. 14 po. $6\frac{1}{2}$ sq. yds.
(*b*) 9 times. 3. (*a*) (1) $9\frac{39}{49}$; (2) 1.
(*b*) ·02525; $\cdot 40\dot{9}$ of £1 is greater by $\frac{1}{100}$ *s*.
4. (*a*) 11 lbs. (*b*) 1*s*. $0\frac{3}{4}$*d*. $\frac{11}{12}$*q*. (*c*) $30\frac{5}{24}$ loads of oats.
5. (*b*) 30*s*.

LXIX. Page 76.

1. (*a*) $87\frac{1}{40}$ yds. (*b*) £365.
2. (*a*) £4. 4*s*. $11\frac{5}{11}$*d*.
   (*b*) (1) $27\frac{3}{11}'$ past 5 o'clock; (2) $43\frac{7}{11}'$ past 5 o'clock.
3. £10. 12*s*. 11*d*.
   (*a*) Mrs Stokes' = 84, Miss Johnson's = 48.
   (*b*) ·01275045...
4. (*a*) 3′. 10″. (*b*) £4880. 12*s*. 6*d*.
5. (*a*) 60. (*b*) 40 days.

LXX. Page 77.

1. (*a*) no. in 6th = 20, no. in 5th = 561, no. in 4th = 155, no. of unplaced = 9. (*b*) 94 boys. (*c*) 2·44...
2. (*a*) 3 mi. 1 fur. 18 po. 1 yd.; 7 hrs. 17 min. $8\frac{4}{7}$ sec.
   (*b*) ·0015, $\cdot 001\dot{3}$.
3. (*a*) (1) 4·475; (2) 2·42937... (*b*) 1.
4. (*a*) £8. 8*s*. $1\frac{1}{4}$*d*. $\frac{2}{5}$*q*. (*b*) $\frac{1}{3}$.
5. (*a*) $3\cdot\dot{4}6153\dot{8}$. (*b*) $2\frac{89}{140}$ days.

LXXI. Page 78.

1. (*a*) 409149. (*b*) 60. (*c*) £6. 14*s*. 2*d*.
2. (*a*) 2*s*. 6*d*. (*b*) $18\frac{3}{4}$ days.
3. (*a*) 5 tons 14 cwt. 1 qr. (*b*) $1\frac{3}{5}$. (*c*) $\frac{54593}{1000000}$, £163779.
4. (*a*) 1st = 2*s*. $4\frac{1}{2}$*d*. a gallon; 2nd = 1*s*. 7*d*. a gallon.
   (*b*) Value of an acre of 1st farm = £52. 10*s*., value of an acre of 2nd = £21.
5. (*a*) 28′. $2\frac{34}{163}''$. past 12 o'clock. (*b*) *A*'s inc. = $\frac{1}{7}$ of *B*'s inc.; £4200.

LXXII. Page 80.

1. (*a*) £1477. 13*s*. $2\frac{19}{384}$*d*. (*b*) £1909. 15*s*. $2\frac{1}{2}$*d*.
2. (*b*) 4·1...
3. (*a*) (1) $1\frac{59}{144}$; (2) 5·042... (*b*) $10\frac{3178}{4284}$. (*c*) $\cdot\dot{3}04509\dot{5}$.
4. (*a*) *C* comes in first, *B* next and *A* last. (*b*) $13\frac{1}{15}$ days.
5. (*a*) $\cdot 0236\dot{1}$. (*b*) £1. 11*s*. 2*d*.

LXXIII. Page 81.

1. (*a*) 25·25 fr., 2525 c., (*b*) 9·83 fr., 983 c.
(*c*) 54·03 fr., 5403 c. (*d*) 309·0775 fr., 30907·75 c.
(*e*) ·855 fr. 85·5 c. (*f*) 740·00125 fr., 74000·125 c.
(*a*) 5·05 kilom., 5050 m. (*b*) ·270027 kilom., 270·027 m.
(*c*) 45·76 kilom., 45760 m. (*d*) ·028005 kilom., 28·005 m.
(*e*) 24·0043 kilom., 24004·3 m.
(*a*) $19·09, 1909 cents. (*b*) $74·004, 7400·4 cents.
(*c*) $1·507, 150·7 cents. (*d*) $·084, 8·4 cents.
(*e*) $·00875, ·875 cents.
2. (*a*) 548 fr. 54·101 c. (*b*) $105. 18 cents. 4·0625 m.
3. (*a*) 12 cents. (*b*) 62 fr. $83\frac{3}{4}$ c. (*c*) 160 pks., $·085.
4. (*a*) (1) $\frac{25}{49}$. (2) 4·00040001. (3) $3\frac{1}{16}$.
(*b*) (1) 513. (2) 2104. (3) 3·1224... (*c*) 85.
5. (*a*) 48 ft. (*b*) $6. $33\cdot\dot{2}$ cents. (*c*) 56 m. 2 decim. 4 centim.

LXXIV. Page 82.

1. (*a*) £1. 19*s*. 2·15*d*. (*b*) 7990.
2. (*a*) (1) 59·049. (2) 2·8284... (3) 4·1683... (*b*) 320.
3. (*a*) £54. (*b*) 18 sq. ft. 37 sq. in.
4. (1) (*a*) 305 fr., 305000 fr. (*b*) 27 fr., 27000 fr.
(*c*) 50 kilom. 7 dekam., 5007 myriam.
(*d*) 1500 myriam. 17 m., 1500001 myriam. 7 kilom.
(2) (*a*) ·17 kilog., 1700 decig.
(*b*) 530·025 kilog., 5300250 decig.
(*c*) ·0000155 kilog., ·155 decig.
(*d*) ·5030057 kilog., 5030·057 decig.
(3) He gained 2031 fr. $33\frac{3}{4}$ c.
5. $195\frac{14}{125}$. (*a*) (1) 74. (2) 809. (*b*) $12\frac{3}{4}$ in.
6. (*a*) 75 ft. (*b*) 40 yds.

LXXV. Page 83.

1. (*a*) (1) 400·06. (2) ·2828... (*b*) (1) ·0015. (2) 1·98...
2. (*a*) 13 ft. 4 in. (*b*) £2. 10*s*. $5\frac{1}{2}$*d*., £5. 18*s*. $1\frac{1}{7}$*d*.
(*c*) 21 ac. 2 ro. 16 po.
3. (*a*) 1 hr. 25 min. 20 sec.
(*b*) 1st, 3 fr. 25 c.; 2nd, 4 fr. 63 c.
(*c*) 50 hectar. 8·0008 ares.
4. (*a*) 9 kilog. 126 grs.
(*b*) *A*'s share = $22. 50 cents, *B*'s share = $15,
C's share = $10.
5. (*a*) £62. 16*s*. $1\frac{1}{3}$*d*. (*b*) 1 sq. yd. 7 sq. ft. 96 sq. in.

LXXVI. Page 84.

1. (*a*) I lose $23. 66 cents. (*b*) 311 yds. 4 in.
2. (*a*) Each part contains 2m. 1decim. 9 centim. $6\frac{52}{63}$ millim.
(*b*) 976 sq. ft. 131 sq. in.
(*c*) Breadth = 4 yds., height = 3 yds. 1 ft.
3. (*a*) Gain = 6 fr. 77 c. (*b*) 1785 fr. 50 c.
4. (*a*) (1) 3005. (2) 300500. (3) ·003005. (4) $5\frac{2}{3}$.
(*b*) (1) 1·505. (2) ·822.
5. (*a*) (1) 500 fr. $26\frac{1}{4}$ c. (2) 446 fr. $6\frac{1}{4}$ c.
(*b*) (1) $8\frac{1}{2}$ ft.
(2) area of each of 2 sides = 18 sq. yds. 8 sq. ft.,
area of each of other 2 sides = 23 sq. yds. 5 sq. ft. 72 sq. in.
(*c*) (1) 10 yds. 1 ft. $5\frac{1}{7}$ in.
(2) 8 sq. yds. 6 sq. ft. $82\frac{2}{7}$ sq. in.

LXXVII. Page 86.

1. (*a*) 7·5 m. (*b*) (1) $3\cdot\dot{8}\dot{1}$ m. (2) $11\cdot\dot{4}\dot{5}$ sq. m. (*c*) 90 fr.
2. (*a*) (1) 46 cub. ft. 19 cub. in.
(2) (*b*) 63 sq. yds. 6 sq. ft. $82\frac{2}{7}$ sq. in. (*c*) 1·6922... m.
3. (*a*) 82 fr. 50 c. (*b*) 2083·587... yds. nearly.
4. (*a*) (1) 59065·932. (2) 4·168... (3) 809. (4) 1·709.
(*b*) $1'.30\frac{10}{11}''$.
5. (*a*) £1. 14*s*. $2\frac{1}{4}$*d*. $\frac{1}{3}$*q*. (*b*) (1) 1 ac. 2 ro. 4 po.
(2) 2 ro. 18 po. $11\frac{1}{2}$ sq. yds.

LXXVIII. Page 87.

1. (*a*) 3 : 11. (*b*) 2 ro. 13 po.
2. (*a*) £94. 10*s*. (*b*) 63.049. (*c*) 18. (*d*) 1700 fr. 16 c.
3. (*a*) (1) Int. = £21. 11*s*. $10\frac{89}{400}$*d*., Amt. = £211. 8*s*. $4\frac{89}{400}$*d*.
Int. = £5. 15*s*. $8\frac{1}{4}$*d*. $\frac{2057}{182500}$*q*., Amt. = £195. 11*s*. $9\frac{1}{4}$*d*. $\frac{2057}{182500}$*q*.
(2) Int. = $1183. $69\cdot8541\dot{6}$. c., Amt. = $4873. $14\cdot8541\dot{6}$ c.
(*b*) (1) £4562. 10*s*. (2) £$3\frac{1}{8}$.
4. (*a*) £4. 6*s*. (*b*) 19*s*. 6*d*.
5. (*a*) £227. 10*s*. (*b*) 308 fr. 38 c.

LXXIX. Page 88.

1. (*a*) (1) ·06. (2) 11 cwt. 3 qrs.
(*b*) (1) the 2nd. (2) 1 man = $2\frac{1}{3}$ boys.
2. (*a*) 127 m. 5 decim. (*b*) £186. 13*s*. 4*d*.
(*c*) $2\frac{7}{8}$ yds. (*d*) 51 men.

3. (*a*) £2. 5*s*. $6\frac{1}{2}$*d*. $\frac{221}{20000}$*q*. (*b*) £3. 1*s*. 8*d*. (*c*) 4800 fr.
4. £3. 5*s*. 1*d*.
5. (*a*) £1550. (*b*) £$3\frac{3}{4}$ per cent.

LXXX. Page 89.

1. (*a*) 1st woman's profit $=\dfrac{104}{237}$ of 2nd woman's profit.

(*b*) horse's appetite $=\dfrac{105}{147}$ of an ox's.

2. (*a*) $7\frac{7}{36}$ days. (*b*) £2. 1*s*. $6\frac{1}{4}$*d*. $\frac{11}{13}$*q*. (*c*) 2 hrs. 34′, 17 rd^s.
3. (*a*) £1904. 8*s*. 9*d*. (*b*) £1. 10*s*. (*c*) 2 boys.
4. (*a*) £1565. 5*s*. $9\frac{1}{3}$*d*. nearly. (*b*) 39 fr.
5. (*a*) 19*s*. $9\frac{1}{2}$*d*. $\frac{50}{101}$*q*., £6. 1*s*. $2\frac{1}{2}$*d*. $\frac{2}{11}$*q*.
(*b*) £375. (*c*) £495. 11*s*. $9\frac{1}{2}$*d*. nearly.

LXXXI. Page 90.

1. (*a*) 57 : 20. (*b*) (1) £98. 18*s*. $2\frac{1}{6}\frac{3}{4}$*d*. (2) 17·0625 day.
2. (*a*) 480 eggs. (*b*) £6037. 10*s*. $4\frac{1}{2}$*d*. (*c*) 1518 men.
3. (*a*) $8\frac{1}{3}$ yrs. (*b*) £67. 18*s*., £61. 8*s*. 8*d*.
4. (*a*) £3. (*b*) 6*s*. $8\frac{3}{4}$*d*. approximately.
5. (*a*) Brother's share is £960. 6*s*. and child's £1920. 12*s*.
(*b*) £900.

LXXXII. Page 92.

1. (*a*) (1) $\dfrac{1}{50}$, ·02. (2) $\dfrac{3}{400}$, ·0075. (3) $\dfrac{1}{20}$, ·05.

(4) $\dfrac{9}{100}$, ·09. (5) $\dfrac{1}{8}$, ·125. (6) $1\frac{1}{4}$, 1·25. (*b*) 579.

2. (*a*) £$23\frac{17}{21}$ gain. (*b*) 12·2262....
3. (*a*) £1342. 10*s*.; £3. 7*s*. $0\frac{1}{4}$*d*. $\frac{157}{176}$*q*. (*b*) £1582,
(*c*) £81. 18*s*. $10\frac{1}{2}$*d*. $\frac{2}{3}$*q*.; £6. 11*s*. $1\frac{1}{4}$*d*. $\frac{1}{3}$*q*.
4. (*a*) 1st receives £369. 7*s*. 6*d*., 2nd receives £886. 10*s*., 3rd £985, and 4th £738. 15*s*.
(*b*) *A* should pay £11. 7*s*. 6*d*., *B* £15. 15*s*., and *C* £8. 5*s*.
5. (*a*) He loses £25 per cent. (*b*) *A*'s share is 7*s*., *B*'s 5*s*. 3*d*., and *C*'s 4*s*. 8*d*. (*c*) £21666. 13*s*. 4*d*.

LXXXIII. Page 93.

1. (*a*) $18\frac{26}{47}$ yrs. or 18·553... yrs. (*b*) $34{\cdot}84\frac{3}{4}^0$.
2. (*a*) (1) $3\frac{1}{2}$ per cent. (2) 2 per cent.
(*b*) $5\frac{3}{4}$*d*. $\frac{1}{13}$*q*., or not less than 6*d*. (*c*) £705. 10*s*.

3. (*a*) £260. (*b*) £34. 4*s*. $10\frac{171}{278}d$.
(*c*) India stock is the better investment, £1. 12*s*. $4\frac{1}{2}d$. $\frac{38}{53}q$.
4. (*a*) *A*'s share is £363, *B*'s £272. 5*s*., *C*'s £190. 11*s*. 6*d*.
(*b*) *A*'s share is £109. 10*s*., *B*'s £171. 10*s*.
5. (*a*) 101 fr. $45\frac{1}{4}$ c. (*b*) \$30. 71·2890625 cents.

LXXXIV. Page 94.

1. (*a*) 20·31. (*b*) $2\frac{1}{2}d$. (*c*) 2*s*. 7*d*.
2. (*a*) $26\frac{4}{21}$, $73\frac{17}{21}$. (*b*) £49. 14*s*. 6*d*.
3. (*a*) £7302. 1*s*. 8*d*.
(*b*) £234. 8*s*. $5\frac{1}{2}d$. approximately. India stock is the best.
4. (*a*) *A* ought to receive 3*s*. $1\frac{1}{2}d$., *B* 1*s*. $10\frac{1}{2}d$.
(*b*) *A* should have £2397. 10*s*., *B* £2021, *C* £3231. 10*s*.
5. (*a*) \$97·732.... (*b*) £14014. 17*s*. $4\frac{1}{4}d$. $\frac{48}{1099}q$.

LXXXV. Page 95.

1. (*a*) $66{\cdot}4\dot{1}4285\dot{7}^{\circ}$.
(*b*) 8*s*. 6*d*., £12. 10*s*. $5\frac{1}{2}d$. $\frac{54}{543}q$.
2. (*a*) $18\frac{3}{4}$ qrs. (*b*) £18. 2*s*. 6*d*.
3. (*a*) It is better to invest in the 3 per cents., £1. 2*s*. $0\frac{1}{4}d$. $\frac{119}{233}q$.
(*b*) £14440. (*c*) £40.
4. (*a*) 8 mo. (*b*) 6 mo.
5. (*a*) £4487. 10*s*.
(*b*) The men receive £4. 15*s*. $7\frac{1}{2}d$., the women £5. 5*s*. $2\frac{1}{4}d$., the children £1. 8*s*. $8\frac{1}{4}d$. (*c*) 623 fr.

LXXXVI. Page 96.

1. (*a*) 10·416...*q*. (*b*) 13 mi. $379{\cdot}3937\dot{3}$ yds.
2. (*a*) $£36\frac{2}{3}$ per cent. (*b*) 3*s*. $8\frac{1}{4}d$. (*c*) £1. 10*s*.
3. (*a*) $4\frac{1}{2}$ per cent. (*b*) $£124\frac{7}{8}$.
4. (*a*) *A* has 180 fr., *B* 225 fr., and *C* 262 fr. 50 c.
(*b*) £2250.
5. (*a*) 32. (*b*) 1235 fl.

LXXXVII. Page 97.

1. (*a*) 4 qrs. 5 bus. (*b*) $£8\frac{9}{52}$.
2. (*a*) £50000. (*b*) £8250 each.
3. (*a*) 10 per cent. (*b*) (1) 90. (2) £465.
4. (*a*) *C* invests £265, *A* ought to have £113. 15*s*., and *B* £136. 10*s*.
(*b*) *A* ought to have £14. 8*s*., *B* £18. 10*s*., and *C* £44.
5. (*a*) \$4204, 80 cents.
(*b*) £1393. 2*s*. $4\frac{3}{4}d$. nearly, gain = £148. 17*s*. $7\frac{1}{4}d$. nearly.

LXXXVIII. Page 99.

1. Pop^n. of Nottingham was 74693, of Peterborough 11735, of Derby 43091.
2. 2*s*. 0$\frac{3}{4}$*d*. 3. £94. 0*s*. 11*d*. 4. 10 ft.; 3 ft. 2$\frac{2}{11}$ in.
5. (1) $\frac{6047}{28936}$. (2) 9$\frac{85}{126}$. (3) 12$\frac{362}{441}$.
6. *B* owes *A* 4$\frac{1}{2}$*d*. 7. $\frac{644}{869}$ day. 8. £78. 2*s*. 6*d*.
9. £3. 18*s*. 1$\frac{1}{2}$*d*. $\frac{30}{43}$*q*. 10. £1092. 14*s*. 6$\frac{1}{2}$*d*. nearly.
11. 60·7346052395510552 cub. in. 13. £5000.

LXXXIX. Page 100.

1. (1) $\overline{\text{VII}}$VI. (2) $\overline{\text{L}}$CCIX, or IↃↃↃCCIX. (3) 210.
2. 7$\frac{3}{4}$*d*. 3. (1) 208. (2) *D* has 49 fr. 80 c. more than *C*.
4. ·003. 5. £367. 10*s*.
6. A sheep : a horse :: 217 : 865. 7. (1) £2. 10*s*.
8. Increase in each case is £11. 5*s*. 6$\frac{3}{4}$*d*. 9. 64 yds.
10. £5977. 11. 46 florins. 12. £631. 5*s*.
13. £2000.

XC. Page 102.

1. 52728340545.
2. Pop^n. of Liverpool was 443938, of Manchester 357979, of Birmingham 296076, of Leeds 207165.
3. 8 turkeys. 4. (1) $\frac{3}{4}$*d*. (2) 20 per cent.
5. The 1st is the better purchase. 6. £154. 3*s*. 4*d*.
7. 3$\frac{69}{70}$. 8. *C* paid £58. 15*s*. 10*d*. 9. *B* had £13. 15*s*.
10. £1. 19*s*. 6$\frac{1}{2}$*d*. $\frac{2}{11}$*q*. 11. 3.0119... 12. £7500.
13. (1) He loses £25. (2) He gains £81.

XCI. Page 104.

1. Number of men = 725, women = 631, children = 256.
2. 9764695 sq. in. (1) 15 sq. ch. 5671$\frac{8491}{39204}$ sq. lks.
(2) 61 ares. 9 deciar. 5·518... centiar.
3. £56. 13*s*. 4*d*. 4. (1) $\frac{270}{81}$. (2) 85. 5. 6$\frac{18}{55}$ days.
6. (1) 84 yds. 1$\frac{1}{3}$ ft. (2) 119·35... yds. 7. ·0042.
8. £10. 1*s*. 10$\frac{3}{4}$*d*. nearly. 9. 37500.
10. Railway stock, £1237. 10*s*. 11. 111·86... sq. m.
12. 70 gulden. 13. 20$\frac{20}{23}$′ past 8 o'clock.

XCII. Page 106.

1. 640 and 350.
2. One travels 13 mi. per hour, the other 7 mi.
3. (1) $\frac{1}{2}$. (2) $2\frac{2062}{4515}$. (3) $\frac{161453}{5324649}$.
4. Each son had £32. 5*s*. 8*d*., each daughter had £24. 16*s*. 8*d*.; they all had £114. 4*s*. 8*d*.
5. £3921. 7*s*. $3\frac{3}{4}$*d*. 6. 98 yds.
7. 450 at 2*s*. and 270 at 3*s*.; £5. 5*s*. $3\frac{3}{16}$*d*. gain per cent.
8. 1600. 9. (1) £495. 9*s*. $10\frac{1}{2}$*d*. (2) $9\frac{1}{2}$*d*.
10. £34. 2*s*. 6*d*. 11. 2 oz. $17\frac{29}{598}$ dwts.
12. Through Hamburgh.
13. The faster 50 mi. an hour, the slower 30 mi. an hour.

XCIII. Page 108.

1. 17646. 13*s*. $9\frac{1}{2}$*d*.
2. 160 lbs. of sugar, 60 lbs. of tea; of flannel and calico 100 yds. of each.
3. (1) 14·0625 per cent. (2) $\frac{55}{72}$.
4. $7\frac{1}{2}$ hrs. *A* will have gone round 3 times, *B* 10, and *C* 4.
5. 408. 6. ·12; $\frac{1}{5}$. 7. No. 20 men.
8. £8. 14*s*. $5\frac{1}{4}$*d*. $\frac{3}{25}$*q*. 9. 25 yrs.
11. *A*'s share is £91. 9*s*. $7\frac{3}{4}$*d*. $\frac{689}{697}$*q*., *B*'s share is £245. 17*s*. 10*d*. $\frac{8}{697}$*q*.
13. *A* will fill it in 90′, *B* in 72′, and *C* in 60′.

XCIV. Page 110.

1. 17 lbs. of tea, 51 lbs. of sugar. 2. £10400.
3. (1) $15\frac{31}{56}$. (2) ·094857. (3) $2\frac{10}{21}$.
4. $\frac{111}{707}$; $\frac{733}{312500}$. 5. (1) 3 hr. 24′. $19\frac{2567}{5587}$″. (2) 4·32 hrs.
6. 4000. 7. (1) 40 gallons. (2) £1. 10*s*.
8. 13*s*. 9. 25 ac. 1 ro. 17 po. 6 yds. 4 ft. $22\frac{4}{5}$ in.
10. (1) $104\frac{9}{16}$. (2) The $3\frac{1}{2}$ at 104 is the better investment. (3) £208. 11*s*. 3*d*.
11. 3*s*. $2\frac{1}{4}$*d*. 12. \$1 = 22·75 reals. 13. 160 qrs., £2.

XCV. Page 112.

1. £520. 16*s*. 2. £700.
3. (1) 902. (2) $\frac{15}{104}$, ·2752057.... 4. £12190. 9*s*. 6¼*d*.
5. It will be more advantageous to employ the boys.
6. 200 yrs. 7. £10. 13*s*. 4*d*. 8. 7234 fr. 37½c.
9. (1) 91·787... ft. (2) From top of town-hall to the base of the church is 144·22... ft.; from top of church to the base of the town-hall is 109·65... ft.
10. 850 fr.; 26 per cent. 11. 3 hrs. 5′.
12. Capital £1500000, receipts £150000. 13. £3780.

XCVI. Page 113.

1. 2×2×2×2×3×5×5×7, 2×2×3×3×3×5×7, 2×2×2×3×7×7×7; G.C.M. 84, L.C.M. 3704400.
2. 19 votes. 3. 18*s*. 11½*d*. 4. 67 gallons.
5. *A* has travelled 10 mi. 1701 yds. 1 ft., *B* 10 mi. 939 yds. 2 ft.
6. $\cdot 0084027\dot{7}$. 7. 16*s*. in the £, 8 per cent.
8. £2. 7*s*. $4\frac{4}{17}d$. 9. (1) 178⅔ po. (2) 70·624... po.
11. 4½ and 5¼ per cent. 12. 4 dwts. 2 grs. nearly.
13. (1) 9.18′. $22\frac{1502}{3949}$″ P.M. (2) 4′. 27½″.

XCVII. Page 115.

1. (1) 7 dekal. 1 lit. 3 decil.
(2) 7491 and 4994; 9988 and 2497.
2. (1) 7¼. (2) 87 ares 5 deciar. (3) $\frac{193}{1890}$.
(4) $\cdot\dot{0}5\dot{3}$. (5) 6·614... 3. ·042968...
4. 8*s*. 5. (1) 9 days. (2) £1. 8*s*. 9½*d*. nearly.
6. 7 qrs. 6 bus. 1 pk. 2·272... qts. 7. $13\cdot 541\dot{6}$.
8. £2153. 10*s*. 9. $7\frac{1}{7}$ mi. 10. 7½*d*. $\frac{10}{21}q$.
11. (1) £353. 10*s*. (2) £9. 10*s*. 12. £2. 19*s*. 2½*d*. $\frac{46}{77}q$.
13. $\frac{7464983}{25735905280}$. 14. 12 wks. 15. £12. 1*s*. 6*d*.

XCVIII. Page 117.

1. (1) MDCCCLXIV, $\overline{\text{VIIII}}$, six hundred millions seven hundred and five thousand and two; ten thousand; fifty thousand; eight thousand. (2) 5334673883463.
2. £50. 5*s*. 8*d*.
3. Each of the 5 who completed the task received £2. 2*s*. 6*d*., and each of the 3 others 12*s*. 6*d*.
4. *A* has 17 hectar. 67 ares, 34·3 centiar.
5. $\frac{17}{27}$, $2\frac{79}{192}$. (1) 7ac. 2ro. 28po. 22sq. yds. $5\frac{11}{14}$ sq. ft. (2) ·9375.
6. The West Riding of Yorkshire; 6·49... per cent.
7. (1) ½. (2) ·0355. (3) $\sqrt[4]{19}$ is the greater.
8. 18*s*. 9. £2000.
10. (1) 4 oz. 5 dwts. $9\frac{7}{9}$ grs. (2) $77\frac{41}{80}$ days.
11. £285; 3½ per cent. 12. 2 yds. 1 ft. $9\frac{6398}{14195}$ in.
13. \$65341$\frac{1}{9}$. 14. *A*'s age is 36, and *B*'s is 27.
15. £254. 8*s*.
16. Gross am^{t}. = £499. 13*s*. 9*d*., sum paid to agent = £9. 11*s*. 9*d*.

XCIX. Page 120.

1. 1st no. is 29, 2nd is 13, and 3rd is 37.
2. (1) 25 fr. $23\frac{1}{13}$ c. (2) 111 doz. and 4 bottles.
3. Sum to be spent = £360, sum to be saved = £240, and sum to be devoted to business = £180.
4. 4 mi. 293 yds. 1 ft. per hour.
5. (1) 3 ac. 2 ro. 11 po. 7 yds. 2 ft. 36 in. (2) 55·5 yds. nearly.
6. (1) 60 per cent. (2) £3200.
7. 3½ per cent., £275. 10*s*. 8. 1 ft. $6\frac{4}{7}$ in., £2.
9. 63 yrs. 10. £350. 11. 270.
12. £105. 13. 3 hrs. 1′. 30″.
14. *A* and *B* will be together in 32′. 24″; *A*, *B* and *C* will be together in 2 hrs. 42′.
15. 2 miles an hour. 16. ·0953101809.

C. Page 122.

1. (1) The number is not divisible by 8 or 9, but is divisible by 11. (2) 42504.
2. 11½*d*. 3. £9000. 4. £32000.
5. $1346\frac{18598}{138637}$. 6. £14240. 7. 8360 in.

8. £11027. 1*s.* $5\frac{1}{4}$*d.* $\frac{99}{125}$*q.* 9. $148\frac{5}{8}$.
10. *A*'s capital=£45000, *B*'s capital=£30000, *A* receives £1950, *B* £1300, and *C* £250.
11. £420. 12. £109. 3*s.* 4*d.*
13. Price on 1st day=$1\frac{5}{8}$*d.*, on 2nd day $\frac{39}{40}$*d.* 14. (1) ·371...
15. Wages of men with horses=£3. 18*s.* $9\frac{3}{4}$*d.*, wages of men with oxen=£4. 7*s.* 9*d.*
16. Income = £153. 7*s.* $1\frac{3}{4}$*d.* approximately, income-tax =£2. 11*s.* $1\frac{1}{4}$*d.* approximately.

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